Maricopa County
Department of Transportation

2003 Congestion Management System Report

Transportation Planning Division
Program & Systems Analysis

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PROGRAM OVERVIEW AND BACKGROUND

Purpose of the CMS

The Maricopa County Congestion Management System sets guidelines for the identification of potential traffic congestion on Maricopa County roadways and implementing procedures for correcting the problem areas. It also measures the effectiveness of MCDOT's congestion reducing strategies by providing annual system wide indicators that can be compared over time.

The five primary purposes for the County's CMS are:

1. To provide a method of identifying and measuring traffic congestion on Maricopa County roadways.
2. To compile information and develop methods for the reduction of traffic congestion on County roads.
3. To facilitate the goals set forth in the County's Comprehensive Plan and the Transportation System Plan to implement a congestion management system.
4. To establish a pool of congestion related projects.
5. To improve the efficiency of travel on Maricopa County roads.

The CMS is part of a larger asset management initiative set in motion by MCDOT recently. Along with the CMS, asset management currently includes bridge, roadway (pavement), safety management systems, and life-cycle analysis.

Past MCDOT Congestion Management Efforts

MCDOT developed its first transportation management systems in 1998 followed by annual updates through 2001. The systems included the previously mentioned congestion, safety, roadways, and bridges. The CMS identified 40.62, miles of congested roads in 1999 compared to 43.36 miles in 2002 based on criteria in the Maricopa County Department of Transportation Roadway Design Manual (RDM).[1] Based on traffic projections, an additional 103.44 miles of roads were identified in 1999 as potentially becoming congested by 2020 compared to 216.42 miles in 2002. Of the combined 259.78 miles of current and projected congested roads, 123.64 miles are expected to exceed absolute capacity (traffic at 100% capacity) by the year 2020.

Increases in projected traffic volumes since 1999 are due solely to improvements in congestion identification techniques used by MCDOT since 1998. This current year (FY 2003) is the first time that MCDOT has been able to fully link traffic volume data to roadway mapping data. This has enabled a more complete and accurate analysis of congestion.

[1] *Roadway Design Manual,* Maricopa County Department of Transportation, November 1993.

MCDOT has developed four Small Area Transportation Studies (SATS). They include the Northwest Valley Transportation Study (NWVTS), Northeast Valley Transportation Study (NEVATS), Southwest Valley Transportation Study (SWVTS), and the Williams Area Transportation Plan (WAPT). These studies focus on current and future traffic congestion on individual roadways. They cover areas within and adjacent to urban and developing areas surrounding the Phoenix metropolitan area. The studies recommended congestion mitigation measures for over 300 existing and proposed new roadways over a twenty-year span. Each study is updated approximately every four years to keep them current. Roadways recommended by the SATs for widening in the next 10 years are listed in Table 1.

In 1995, MCDOT developed the "MCDOT Congestion Management System (CMS) Assessment: Alternative Congestion Management Strategies in Maricopa County." Its purpose was to evaluate congestion reducing strategies that do not increase single occupancy vehicle use. The study examined eleven federal CMS requirements and explained MCDOT's efforts in fulfilling these requirements. It also described the Arizona Department of Transportation's (ADOT) and the Maricopa Association of Governments' (MAG) actions and roles in the CMS and its development.

Table 1: Roadways Recommended for Widening by the Small Area Transportation Studies

Road Name	From	To	Project Type	Time Horizon	Development Status
91st Ave	Roosevelt St	Van Buren St	Widen from 2 to 4 lanes	0 to 5 years	
115th Ave	Van Buren St	Brinker St	Widen from 2 to 4 lanes	0 to 5 years	Design
Elliot Rd	157th St	159th St	Widen from 2 to 4 lanes	0 to 5 years	Construction
Elliot Rd	Gilbert C/L	Eastern Canal	Widen from 2 to 4 lanes	0 to 5 years	
Gilbert Rd	Queen Creek Rd	Chandler C/L	Widen from 2 to 4 lanes	0 to 5 years	Corridor Study
Gilbert Rd	Ryan Rd Align	GermannRd	Widen from 2 to 4 lanes	0 to 5 years	Corridor Study
Greenfield Rd	Eastern Canal	Gilbert C/L	Widen from 2 to 4 lanes	0 to 5 years	
Higley Rd	Houston Ave	Gilbert C/L	Widen from 2 to 6 lanes	0 to 5 years	
Indian School Rd	Reems Rd	Clubhouse Dr	Widen from 2 to 4 lanes	0 to 5 years	
Power Rd	Guadalupe Rd	Kiowa Ave	Widen from 4 to 5 lanes	0 to 5 years	Design
Sarival Ave	Lower Buckeye Rd	Van Buren St	Widen from 2 to 3 lanes	0 to 5 years	
Van Buren St	115th Ave	99th Ave	Widen from 2 to 6 lanes	0 to 5 years	
Camelback Rd	Bullard Ave	Litchfield Rd	Widen from 2 to 4 lanes	5 to 10 years	
Desert Hills Dr	33rd Ave	19th Ave	Widen to 4 lanes	5 to 10 years	
Guadalupe Rd	Gilbert C/L	172nd St	Widen from 2 to 4 lanes	5 to 10 years	
Pioneer Rd	I 17	Proposed TI near Deadman Wash	Widen to 6 lanes	5 to 10 years	
Recker Rd	Houston Ave	Gilbert C/L	Widen from 2 to 4 lanes	5 to 10 years	
Yuma Rd	Cotton Ln	Sarival Ave	Widen from 2 to 6 lanes	5 to 10 years	

Each year MCDOT identifies and assesses all roads identified with potential congestion problems. Roads that are good candidates for congestion mitigation are recommended for further study to determine if they should be included in the

MCDOT Transportation Improvement Program (TIP).

ROADS FOR PRIORITY CONSIDERATION

Maricopa County uses this CMS as a tool to determine management policies, and identify and prioritize roads for congestion mitigation. Tables 2 and 3 list road segments that have been identified for priority consideration and possible further study. Selections were based primarily on "Absolute Capacities" (capacities determined by the number of lanes only) and secondarily by MCDOT Roadway Design Manual capacity criteria. These selection criteria are described in more detail later in this report.

Table 4 lists 21 intersections for potential congestion mitigation. Capacities are based on a modified Highway Capacity Manual (HCM) approach. This method is describe later in this report.

Table 2: Primary Roads Selected for Priority Consideration Based on Absolute Capacities. (Sorted by "Current Absolute V/C")

Road	Current ADT	2003 LOS	2010 LOS	2020 LOS	Current Absolute V/C	2010 Absolute V/C	2020 Absolute V/C	Lanes	Miles
Bell Rd (Burns Dr to Peoria C/L)	50,788	C	B	A	0.75	0.61	0.55	6	0.18
Mc Dowell Rd (Alma School Rd to Extension Rd)	16,055	A	E	E	0.46	0.92	0.94	4	0.5
Mc Dowell Rd (Extension Rd to Arizona Ave)	13,536	A	E	E	0.39	0.93	0.93	4	0.27
Queen Creek Rd (Chandler C/L to Gilbert Rd)	6,103	A	D	F	0.39	0.83	1.14	2	0.13
051st Ave (South St Johns to Continuous)	5,891	A	C	B	0.37	0.76	0.64	2	0.75
051st Ave (Continuous to Ray Rd)	5,891	A	C	B	0.37	0.76	0.64	2	1
051st Ave (Ray Rd to Grir Boundry)	5,891	A	C	B	0.37	0.76	0.64	2	0.25

Table 3: Secondary Roads Selected for Priority Consideration Based on Absolute Capacities (Sorted by "Current Absolute V/C")

Road	Current ADT	2003 LOS	2010 LOS	2020 LOS	Current Absolute V/C	2010 Absolute V/C	2020 Absolute V/C	Lanes	Miles
051st Ave (Lower Buckeye Rd to Phoenix C/L)	18,051	F	E	F	1.15	0.92	1.46	2	0.5
Thunderbird Blvd (Del Webb Blvd to Camelot Cir)	17,556	F	F	F	1.11	1.31	1.66	2	0.15
Guadalupe Rd (Gilbert C/L to 172nd St)	13,523	D	D	F	0.86	0.88	1.13	2	0.44
Union Hills Dr (107th Ave to Welk Dr)	12,788	D	E	F	0.81	0.92	1.11	2	0.15
Broadway Rd (Phoenix C/L to 027th Ave)	12,158	C	F	F	0.77	1.28	1.81	2	0.99
Union Hills Dr (Welk Dr to 104th Ave)	12,177	C	E	F	0.77	0.92	1.11	2	0.22
Mc Kellips Rd (Hayden Rd to Sr101)	22,122	B	F	F	0.63	1.08	1.05	4	1

Table 4: Intersections Selected for Priority Consideration

Intersection	Average V/C	V/C Range (lowest leg – highest leg)	Control Devices	Potential Improvement
098TH AVE / BELL RD	1.88	1.65–2.11	Signal	Further study. Only 2 legs analyzed. Possibly retime signal.
099TH AVE / BELL RD	1.64	0.87–2.68	Signal	Possibly retime signal short-term. Add lanes long-term.
114TH AVE / BELL RD	1.42	1.42	Signal	Further study. Not enough legs to make decision.
BELL RD / BOSWELL BLVD	1.36	0.70-2.68	Signal	Possibly retime signal short-term. Add lanes long-term.
BELL RD / BURNS DR	1.32	0.55-1.76	Signal	Possibly retime signal.
BELL RD / DEL WEBB BLVD	1.21	0.83-1.56	Signal	Possibly retime signal short-term. Add lanes long-term.
GRANITE VALLEY DR / MEEKER BLVD	1.12	1.07-1.19	Stop/ Stop	Investigate signal installation.
107TH AVE / DEL WEBB BLVD	1.1	0.66-1.44	Stop/ Stop	Investigate signal installation.
107TH AVE / UNION HILLS DR	1.09	0.83-1.35	Stop/ Stop	Only 2 legs analyzed. Investigate signal installation.
ALEPPO DR / MEEKER BLVD	1.09	1.09-1.09	Stop/ Stop	Only 2 legs analyzed. Investigate signal installation.
051ST AVE / LOWER BUCKEYE RD	1.05	0.23-1.88	Signal	Possibly retime signal.
CAMINO DEL SOL / MEEKER BLVD	0.94	0.63-1.09	Stop/ Stop	Investigate signal installation.
091ST AVE / NORTHERN AVE	0.88	0.70-1.14	Signal	Possibly retime signal.
099TH AVE / THUNDERBIRD BLVD	0.87	0.40-1.15	Signal	Possibly retime signal.
107TH AVE / OLIVE AVE	0.85	0.57-1.15	Signal	Possibly retime signal.
BROADWAY RD / ELLSWORTH RD	0.82	0.41-1.60	Signal	Possibly retime signal.
RECKER RD / UNIVERSITY DR	0.8	0.58-1.06	Signal	Possibly retime signal.
CAMINO DEL SOL / SPANISH GARDEN DR	0.76	0.28-1.25	Stop/ Stop	Investigate signal installation.
103RD AVE / THUNDERBIRD BLVD	0.66	0.38-0.98	Signal	Possibly retime signal.
ELLSWORTH RD / SOUTHERN AVE	0.59	0.07-1.09	Signal	Possibly retime signal.
EL MIRAGE RD / OLIVE AVE	0.44	0.17-1.16	Stop/ Stop	Investigate signal installation.

LAWS AND POLICIES AFFECTING THE CMS

Metropolitan Planning Strategy Requirements

The 1998 Transportation Equity Act for the 21st Century (TEA-21) recommends Municipal Planning Organizations (MPO), such as MAG, consider projects that promote seven planning strategies in the transportation planning process (Title 23 134(f)(1)). The regulations state that the MPO "shall provide for consideration of projects and strategies that will":

1. "Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity and efficiency."
2. "Increase the safety and security of the transportation system for motorized and nonmotorized users."
3. "Increase the accessibility and mobility options available to people and for freight."
4. "Protect and enhance the environment, promote energy conservation, and improve quality of life."
5. "Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight."
6. "Promote efficient system management and operation."
7. "Emphasize the preservation of the existing transportation system."

However, regulations also explain that failure to consider any of the above strategies "…shall not be reviewable by any court…" (Title 23 134(f)(2)). This means there are no penalties for non-compliance. While the above metropolitan planning strategies are not required by MCDOT, MCDOT has determined that meeting these strategies is in the best interest of the public.

Other Laws and Policies

The Federal Highway Administration (FHWA) oversees and recommends the general design of federal aid roadways and regulates the flow of federal monies to transportation projects. The FHWA also enforces the regulations in TEA-21. In order to receive federal funding, an applicant must meet the stipulations set forth in TEA-21. These regulations not only affect the design of roadways, but also provide recommended management practices and enforce air quality laws. MCDOT typically receives $1-5 million per year in federal funds. This equates to usually less than 3% of the MCDOT capital budget.

Local jurisdictions are encouraged to operate and make decisions within the guidelines recommended by the County transportation management systems including the CMS. Municipalities are often the only source of needed information for County planning purposes and their cooperation is important to project selection and the success of the CMS. Local jurisdictions are also a source for some of the

project requests that eventually become Transportation Improvement Program (TIP) projects. These jurisdictions often become partners with MCDOT in improving these roadways.

The MCDOT five-year TIP is used to design and construct Maricopa County roadway projects. A majority of projects that are selected for the TIP are chosen because they were first identified as congested roadways. The TIP makes available the necessary funding and methods for the implementation of the CMS in addition to the funding required for improvements to other non-congestion related projects.

The MCDOT Transportation System Plan (TSP) is the guiding document for the planning and construction of County transportation facilities. It is described in more detail in the next section.

ROLE OF THE CMS IN TRANSPORTATION IMPROVEMENTS PROGRAMMING

The primary purpose of the CMS in the TIP process is to identify individual road segments, or intersections where traffic congestion is currently a problem or may be a problem in the future. It also provides recommendations for road improvements in the TIP. Several projects are annually selected for the TIP. Most are selected for capacity enhancements. This requires a pool of potential projects, many of whom are provided through the CMS.

Transportation System Plan

The TSP sets the overall policies, goals, and fundamental considerations that direct MCDOT decisions concerning current and future transportation needs and investments. The TSP establishes the need for management systems, including a CMS, to help identify and plan future roadway improvements. In addition to management systems, it addresses current and future roadway needs and promotes alternative modes of travel including transit, bikeways, and pedestrian facilities. The TSP also recommends investment priorities based on three types of routes; primary, secondary and local. Much of the content of the TSP regarding CMS development and actions are a reflection of the Comprehensive Plan's guidelines for transportation management.

CMS OBJECTIVES

Objectives Based on the Comprehensive Plan

The adopted Maricopa County Comprehensive Plan directs the management of the County's public works. It calls for the coordination of development, conservation of natural resources, effective expenditures of public monies, and the promotion of the

[1] *Maricopa County Comprehensive Plan*, Maricopa County, Arizona, October 1997.

health, convenience and welfare of the County's citizens.[1] Several objectives related to congestion must be addressed by the CMS in order to fulfill the transportation directives set forth in the County's Comprehensive Plan. They are:

1. Reduce the proportion of trips made in single occupancy vehicles.
2. Increase transit ridership.
3. Employ applicable technology to improve the use of transportation facilities.
4. Identify and accommodate transportation corridors.
5. Optimize public investment.
6. Minimize travel times.

Objectives Based on the Transportation System Plan

The adopted Transportation System Plan (TSP) provides for the management of the Maricopa County roadway network. Its goals are to "set forth a vision for the planning and construction of transportation facilities within Maricopa County through the year 2020."[1] Several objectives must be addressed by the CMS in order to accomplish the CMS goals set forth in the TSP. They are:

The CMS should recommend ways to ease congestion including:

1. Roadway widening.
2. Intersection improvements.
3. Alternate route enhancement.
4. Establish parking rules that influence traffic congestion reduction.
5. Improvements to bicycle and pedestrian facilities.
6. Provide for both current and future traffic volume data needs.
7. Monitor and measure congestion reduction.
8. Help decide what improvements are needed.
9. Identify alternative actions.
10. Recommend cost-effective mitigation measures.
11. Evaluate actions related to congestion management.

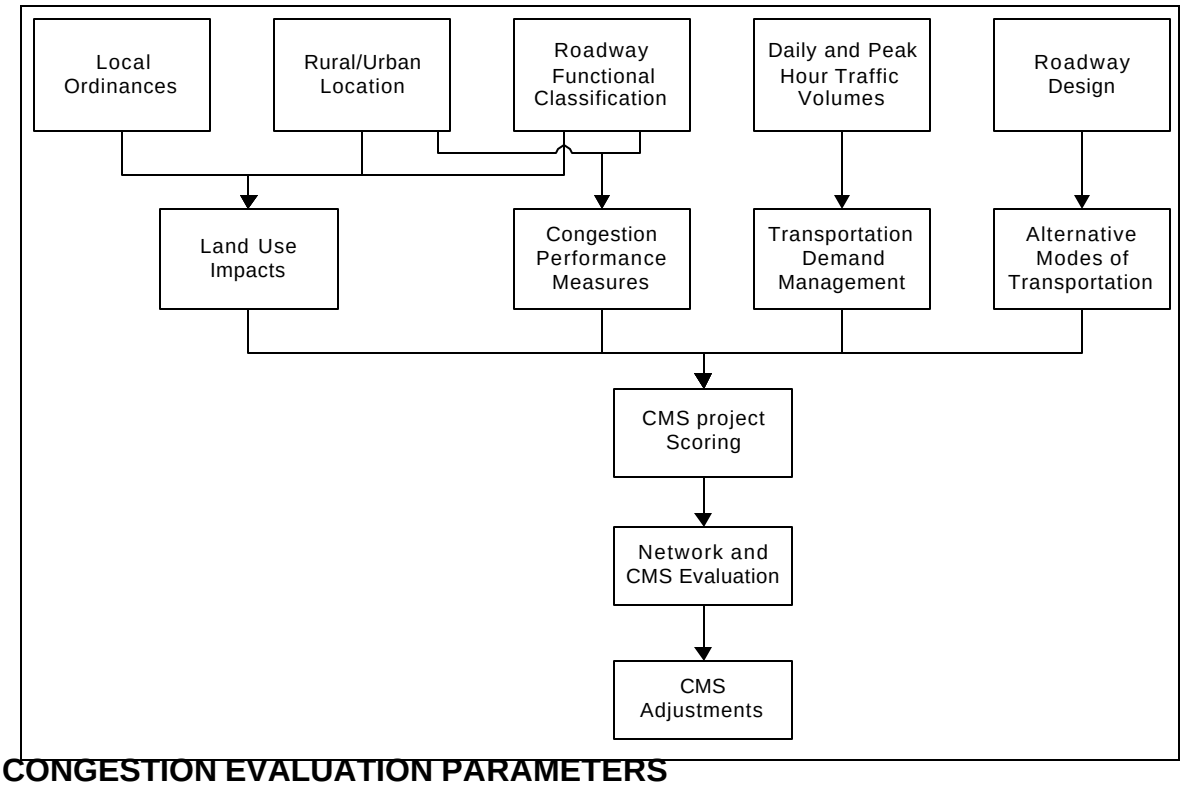
Objectives Based on MCDOT TIP

The TIP provides for the identification, funding, and improvement of County roadway projects. MCDOT addresses the following guidelines when implementing the CMS to maximize the effectiveness of TIP programming:

1. Application of CMS procedures and policies should be consistent throughout the County and when dealing with each jurisdiction.
2. All significant factors that contribute to or affect traffic congestion should be considered in the CMS.

[1] *Transportation System Plan*, Maricopa County, Arizona, December 1997.

3. The cost of mitigating traffic congestion impacts should be shared equitably with all agencies and jurisdictions that contribute to those impacts.
4. The CMS should be consistent with all governing legislation, MCDOT policies, and design standards.
5. The CMS should attempt to provide for the most reasonably effective solution to traffic congestion problems in Maricopa County at the lowest cost to the public.
6. The CMS should provide for self-evaluation and revision when needed.



CONGESTION EVALUATION PARAMETERS

One of the most important steps to consider when evaluating projects for congestion mitigation is determining the parameters that best identify traffic congestion. These include, roadway functional classification, land use impacts, alternative modes of transportation, and congestion indicators (Figure 1). In addition, the extent that each project affects congestion on County roadways must be weighed and applied to mitigation efforts equal to the level of its effects.

Definition of Congestion

A widely accepted definition of traffic congestion is not firmly established because congestion is primarily a perceived condition rather than an absolute one. However, several definitions have been offered by transportation agencies throughout the

country.

The Federal Highway Administration's (FHWA) Interim Final Rule for the Management Systems element of the original ISTEA defined congestion as "the level at which transportation system performance is no longer acceptable due to traffic interference."[1]

MAG uses volume to capacity ratios (v/c) for identifying congestion.[2] In addition, the *Congestion Management Systems Alternatives* report prepared by MAG also suggests Levels of Service (LOS) can define congestion.[3] A road's LOS is based on the percentage of traffic it experiences in relation to its 100% capacity. The MAG EMME/2 traffic projection computer model sets the LOS for roadways as follows:

1. LOS A: Operating under 60% of capacity
2. LOS B: Operating at 60% to 70% of capacity
3. LOS C: Operating at 70% to 80% of capacity
4. LOS D: Operating at 80% to 90% of capacity
5. LOS E: Operating at 90% to 100% of capacity
6. LOS F: Operating over 100% of capacity

MCDOT Roadway Design Manual Definition

The MCDOT Roadway Design Manual uses a combined functional classification and LOS system for defining congestion. This provides both a hard measure of congestion and the flexibility to view individual road segments based on their general characteristics. To determine whether a segment is congested, a minimum desired LOS is first assigned based on its functional classification (Table 5). Local roads are classified at LOS A, collectors at B and C, and arterials at C and D depending on their urban or rural classification and whether they are classified as minor, major or principle roadways. Roadway capacities are established based on their desired minimum LOS and adjusted for their number of lanes. Their traffic volumes are then divided by their roadway capacities to see if they exceed the desired LOS.

The rational for the definition of congestion of an individual roadway segment in this CMS is based on the desired operation of a roadway. If traffic volumes exceed the desired roadway capacity, the road is considered congested. For this CMS report, congestion of a specific roadway segment is, therefore, defined as any situation where the traffic on that segment is delayed on a regular basis. Delays must be due

[1]Metropolitan Planning Technical Report No. 2, Congestion Management Systems, U.S. Department of Transportation Federal Highway Administration, July 1994.
[2]Maricopa County Association of Governments, MAG Transportation Management Systems Report FY 1997 Update, draft report, Nov 1996.
[3]Maricopa Association of Governments, Congestion Management Systems Alternatives, Final Report, April 1994

Table 5: MCDOT Roadway Design Manual Urban and Rural Roadway Levels of Service and Service Volumes

Urban Roadway Level of Service and Service Volumes							
Road Classification	Desired LOS	ADT/Lane	# Thru Lanes	2-Way ADT	Pk.Hr/ ADT%	Max. Pk. Hr. Ln. Vol	Max Rdwy Length
Local	A	350	2	50 -700	15	60	1,000 ft.
Minor Collector	B	2,500	2	500 - 5,000	12	360	½ mi.
Major Collector	C	3,500	2	600 - 7,000	10	420	2 mi.
Minor Arterial	C	5,500	4	6,000 - 22,000	8	530	--
Principal Arterial	D	7,500	6	18,000 - 45,000	8	720	--
Rural Roadway Level of Service and Service Volumes							
Road Classification	Desired LOS	ADT/Lane	# Thru Lanes	2-Way ADT	Pk.Hr/ ADT%	Max. Pk. Hr. Ln. Vol	Max Rdwy Length
Local	A	500	2	50- 1,000	15	90	1 mi.
Minor Collector	B	3,000	2	800 - 6,000	12	430	2 mi.
Major Collector	B	4,000	2	1,000 - 8,000	10	480	--
Minor Arterial	C	9,000	4	6,000 -36,000	10	1,100	--
Principal Arterial	C	10,000	4	10,000 - 40,000	10	1,200	--

The chart information should be used in conjunction with other factors such as the "Continuity" of the road, and its section-line or mid-section alignment. Note the overlapping range of ADT is intended to allow for consideration of these other factors.

All chart information is based on a 60% Peak Hour (Pk. Hr.) directional split. ADT refers to Average Daily Traffic (24-hour weekday, two-way volume). LOS refers to Level of Service. A summary description of Level of Service is given below:

A - free flow, with low volumes and high speeds.
B - reasonably free flow, but speeds beginning the restricted by traffic conditions.
C - in stable flow zone, but most drivers restricted in freedom to select their own speed.
D - approaching unstable flow, drivers have little freedom to maneuver.
E - unstable flow, may be short stoppages.

Sources: American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets, 1990. p.92. For additional discussion of Levels of Service, see pp. 89 - 92. Length may be variable as a function of degree of home frontage on the road.

to larger traffic volumes on the roadway than is desired based primarily on absolute capacities and secondarily on MCDOT Roadway Design Manual capacity criteria.

EVALUATION OF CONGESTION

In accordance with past federal recommendations, the following eleven strategies were evaluated for each project prior to recommending the addition of general purpose Single Occupant Vehicle (SOV) lanes:

1. Transportation demand management measures.
2. Traffic operational improvements.
3. HOV usage.
4. Public transit capital.
5. Public transit operational.
6. Non-traditional mode usage.
7. Congestion pricing.

8. Growth management and activity center strategies.
9. Access management techniques.
10. Incident management on County roadways.
11. Intelligent Vehicle Highway System.

Current federal law no longer requires evaluating these strategies, but MCDOT considers them to be good management practice and therefore still applies them in congestion mitigation.

CMS Performance Measures

Accurate identification of congestion on roadway segments and intersections is critical to the effective management of the entire network. This CMS identifies individual road segments where congestion is a problem. Once identified, these congested road segments can be studied further for possible inclusion in the County Transportation Improvement Program (TIP).

MCDOT uses traffic volume to roadway capacity ratios (V/C) because they best identify congestion while satisfying County congestion management needs. V/C ratios typically use the average number of vehicles (in the most recent year) that travel a road per day divided by the number of vehicles that the road can reasonably handle per day.

V/C ratios therefore represent the proportion (or percentage when multiplied by 100) of vehicles that actually travel a road to the maximum number of vehicles that can use the road before significant delays will occur due to traffic congestion. Quite often V/C ratios exceed 1.00 for individual roads. This indicates that significant delays are likely and the road may need widening or some other capacity enhancing action to reduce congestion. The advantages of using V/C ratios include:

1. V/C ratios are good at measuring congestion on rural and non-freeway roads. Nearly half of Maricopa County roads are rural while none are freeways.
2. V/C ratios are applicable to assessing congestion in small areas or at small scales. One of the primary purposes of the CMS is to identify congestion at small-scale levels such as individual roadway segments because most County roadway improvements are made on the segment level.
3. The data required for v/c ratios are readily available. In Maricopa County, traffic counts are collected annually for many primary and secondary roads.
4. V/C ratios are easier to understand and calculate than other measures.
5. V/C ratios and traffic volumes can be projected to analyze future roadway networks. The rapid population growth in Maricopa County and resulting growth in vehicle miles of travel requires improvements to the County's roadway network to keep pace. This ability to project network changes is very important in anticipating future roadway capacity needs.

MCDOT's maximum desired congestion thresholds becomes undesirable when V/C ratios are approximately 60% to 90% of absolute capacity. However, absolute capacities do not account for roadway design (except for the number of lanes) and the functional classification of roadways. Absolute capacities are also based on ideal conditions, and are therefore usually higher than capacity measures that account for these other factors.

V/C ratios are normally limited to measuring traffic congestion on individual roadway segments or intersections, not at system wide levels. In addition, v/c ratios do not account for the movement, speed or delay of vehicles and are therefore not considered to be a direct measure of congestion. V/C ratios must first be compared to thresholds to determine whether a road is within is range of desired traffic volumes. In order to accomplish this, MCDOT uses a “V/C index” that more directly measures congestion at desired capacities to evaluate road segments. The "v/c index" uses the desired maximum capacity in place of the roadway's absolute capacity. The v/c index is therefore expressed as:

$$\text{V/C index} = \frac{\text{average daily traffic volume}}{\text{maximum capacity at the desired level of service (LOS)}}$$

This can be compared to the typical V/C ratio expressed as:

$$\text{V/C ratio} = \frac{\text{average daily traffic volume}}{\text{absolute capacity}}$$

The advantages of using the v/c index are:

1. The desired LOS is incorporated into the V/C index eliminating the need to compare v/c ratios to the absolute LOS to determine if the threshold has been reached.
2. It provides a threshold value of “1" to indicate whether a roadway has exceeded its desired LOS.
3. The desired LOS can be adjusted for roadway classification and location (urban or rural) facilitating comparison of the differing roadway types and locations in Maricopa County.
4. It provides a numeric value that can be easily used via computer for analytical procedures.
5. It is easily used in forecasting future traffic congestion.
6. Volume and capacity data is readily available making it an economical method.

Projected congestion on road segments is also measured using the V/C index and absolute levels of service (LOS F). Presently, MCDOT employs the MAG EMME/2 computer model for projecting traffic volumes. The EMME/2 model is used by MAG to predict future traffic volumes on the arterial roads. The model is also used by MCDOT to identify individual roadways that may experience congestion problems

over time. The model does not include local roads and roadways substantially outside the Phoenix metro area. For the purpose of system wide identification of congestion on Maricopa County roadways, the MAG EMME/2 model meets the needs of the County. The EMME/2 model uses trip rates, land uses, employment data, and socioeconomic data to project traffic volumes on current and future roadways.

Rural and local roadways do not usually experience significant traffic congestion. A data intensive system for identifying future congestion in these areas is therefore not warranted given the cost of data collection and manipulation. Most of the relatively small numbers of rural segments that may become congested in the future are likely to be identified by the MAG EMME/2 model as it expands to cover a larger geographic area. The remaining road segments outside the modeled area are identified using more short-term techniques, such as monitoring complaints and historic traffic counts.

For the primary and secondary roadways in the network that are covered by the EMME/2 model, a series of EMME/2 model maps and databases are produced projecting 10-year and 20-year traffic volumes. Absolute v/c values are computed for each segment and a list of anticipated congested roadways are compiled. The projects with the highest current v/c values are evaluated each year. Recommendations for TIP projects are made based on a project's level of congestion and other MCDOT management criteria.

Area of Consideration

Geographically, the CMS is applied within the confines of Maricopa County and to roadways that are partially or completely under Maricopa County ownership or control. The roadway network is grouped into primary, secondary, and local roads totaling approximately 5,800 lane miles (Fig 6, pg 48). This report evaluates the primary (approx. 650 miles) and secondary (approx. 1,150 miles) roads. The majority of County roads are adjacent to or near cities and towns that are often the main traffic generators for these roadways. County island roadways (roadway segments surrounded by one or more municipalities) account for about 900 miles of the 2,680 centerline miles of total roadway in the system.

Current and Future Traffic Congestion

The primary congestion indicator for road segments used in this CMS employs absolute capacities. Absolute capacities are used as the main indicator because they provide more conservative estimates of congestion than do MCDOT Roadway Design Manual (RDM) criteria. The County roadway network has few congested roads based on the RDM criteria. RDM criteria give good indicators of potential problems, and are used primarily to provide secondary selection criteria for project recommendations.

As shown in Table 6, approximately 1.4% of arterial (2.63 center line miles, 5.98 lane-miles) and 0.7% (12.53 center line miles, 16.42 lane-miles) of collector roads that are not currently being studied are considered congested based on RDM

Table 6: Summary of Potentially Congested Center Line Miles of County Roads That Are Not Under Study. Based on MCDOT Roadway Design Manual Criteria and Absolute Capacities (miles).

Functional Class	Miles Congested in 2003 Based on…		Miles Expected to be Congested by 2010 Based on…		**Total Miles Congested based on…**		Total CL Miles in County Net-work
	RDM	Absolute Capacity	RDM	Absolute Capacity	**RDM**	**Absolute Capacity**	
Arterial	2.63	0.00	9.90	1.00	**12.53**	**1.00**	182.26
Collector	8.21	0.65	35.35	5.29	**43.56**	**5.94**	1,245.56
TOTAL	10.84	0.65	45.25	6.29	**56.09**	**6.94**	2,679.96

criteria. An additional 2.8% of arterials (12.53 center line miles, 27.92 lane-miles) and 2.8% (43.56 center line miles, 72.46 lane-miles) of collectors may become congested by 2010 based on RDM criteria.

Table 6 also shows the miles of congested road segments based on absolute capacities (100% capacities based on the number of lanes regardless of functional class) that are not already under study. Absolute capacities indicate much less congestion than do capacities using RDM criteria. Based on absolute capacities, no arterial and 0.05% of collector roads that are not currently being studied are now operating at LOS F. Approximately 0.26% (15.88 lane-miles) of all arterial and collector roads that are not currently being studied are expected to experience congestion between the years 2004 and 2010 based on absolute capacities.

Table 7 provides the miles of current and future congested county road segments that are under study. Approximately 44% of currently congested county roads and 35% of county roads that are projected to be congested by 2010 based on RDM criteria are under study (Candidate Assessment Reports (CAR), Design Concept

Table 7: Summary of Potentially Congested County Roads That Are Under Study. Based on MCDOT Roadway Design Manual Criteria and Absolute Capacities (miles).

Functional Class	Miles Congested in 2003 Based on…		Miles Expected to be Congested by 2010 Based on…		**Total Miles Congested based on…**		Total Miles in County Net-work
	RDM	Absolute Capacity	RDM	Absolute Capacity	**RDM**	**Absolute Capacity**	
Arterial	1.00	0.00	3.11	2.73	**4.11**	**2.73**	182.26
Collector	7.45	0.00	21.38	5.12	**28.83**	**5.12**	1,245.56
TOTAL	8.45	0.00	24.49	7.85	**32.94**	**7.85**	2,679.96

Reports (DCR) or designs). There are no county roadways currently determined to be congested based on the absolute capacity criteria. Also, based on the absolute capacity criteria, 56% of those roadways anticipated to be congested by 2010 are already under study to determine appropriate mitigation.

According to Figures 2 and 3 on the following pages, more miles of two lane roads are projected to be congested than four lane roads. This equates to approximately seven times more secondary road miles being as congested than primary system road miles.

Table 8 on page 21 lists 154 congested and potentially congested arterial and collector roadway segments based on RDM criteria that are not currently being studied. Their cumulative length equals 56.09 miles (Table 3). Of these segments, 17 are on primary system routes and 137 are on secondary routes. The MAG EMME/2 computer model doesn't project traffic volumes on local or rural roads so future traffic volumes were projected to increase at a rate of 2.38% per year for roads not covered by the EMME/2 model. The 2.38% value is a conservative estimate based on a national average for traffic growth. In addition, Table 8 identifies segments that are only "potential" problems based on the MCDOT Roadway Design Manual. Further study is required to determine if any of these identified segments actually experience traffic congestion.

The Purpose for Using Absolute Capacities to Measure Congestion

Assessing congestion based only on the RDM suggested capacities might not provide a realistic or complete picture of congestion on County roads for the purposes of the CMS. As Table 5 from the RDM shows, a two lane urban local road is assigned a capacity of 700 vehicles per day, but a two lane rural major collector is given a capacity of 8,000 vehicles per day, or over 11 times the capacity of the urban local road. Given this comparison, an urban local road can obviously handle more than 700 vehicles per day. The RDM capacities therefore provide only preferred operating characteristics for roads and is primarily intended for roadway design rather than congestion management purposes. RDM criteria are also used for planning purposes to identify potential congestion on roads before problems actually occur. A better check on how roads are functioning is accomplished by calculating their levels of service based on absolute capacities. There are significantly fewer road segments that are congested based on absolute capacities than based on the RDM criteria as Tables 8 and 9 show.

Tables 8 and 9 also lists 53 currently congested segments (19.29 CL miles) based on RDM criteria. Eleven of those segments (8.45 CL miles) are currently being studied. However, based on absolute capacities, only 2 (0.65 CL miles) of those 53 segments are currently at LOS F. Only six additional segments (3.62 CL miles) reach LOS F by 2010 based on the absolute capacity criteria.

Figure 2: Center Line Miles of Potentially Congested Primary County Roads

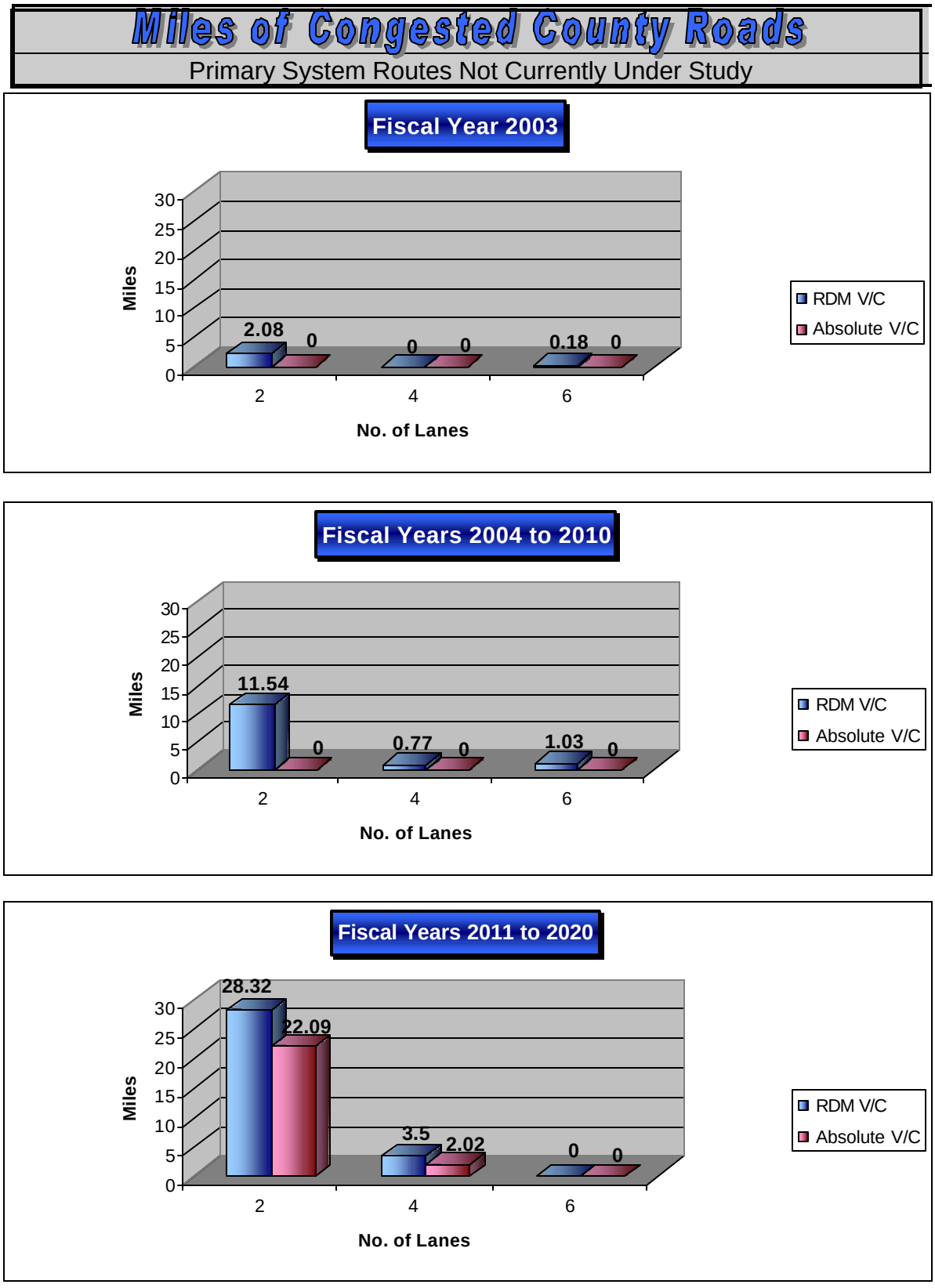


Figure 3: Center Line Miles of Potentially Congested Secondary County Roads

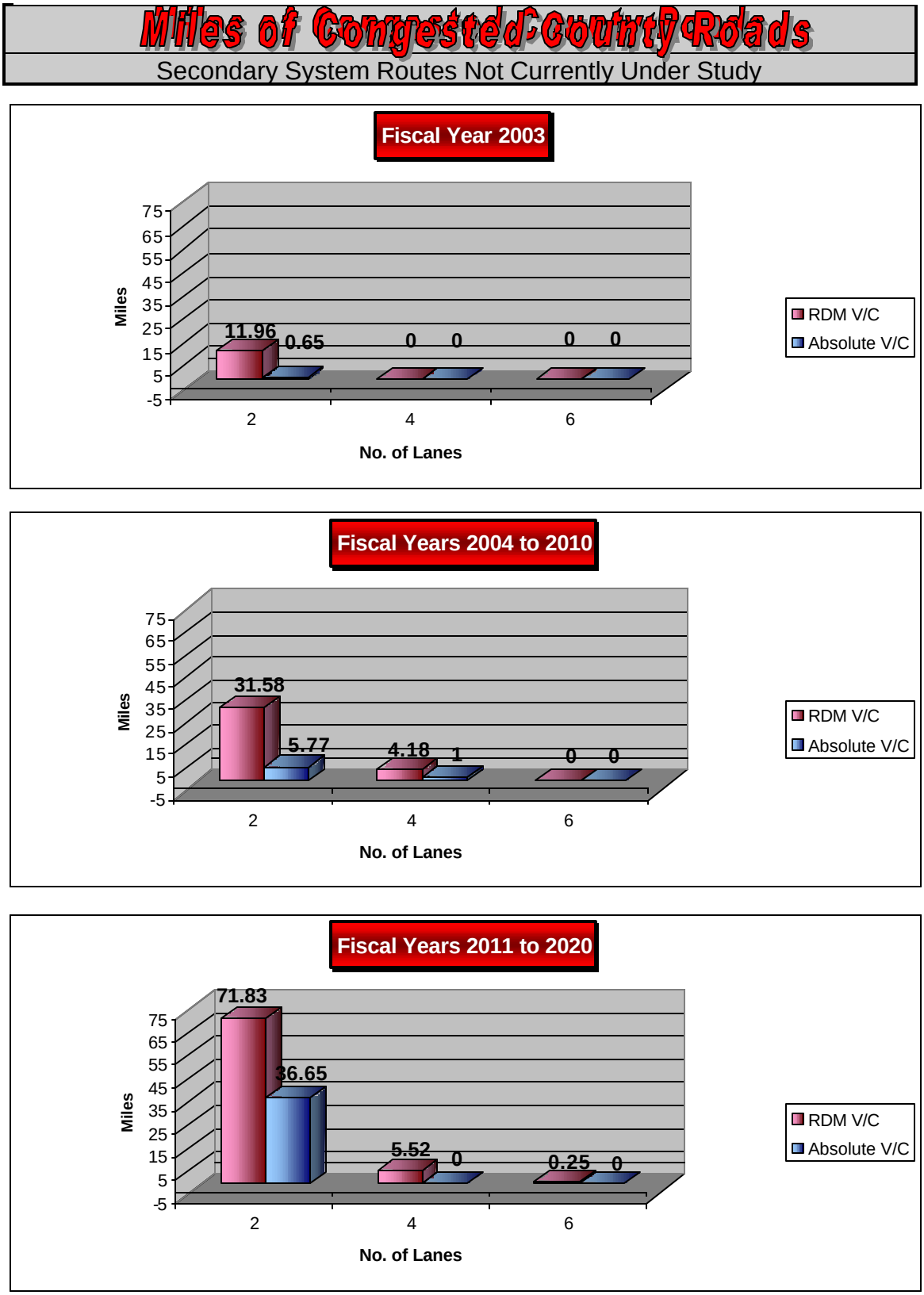


Table 8: Current and Projected Congested Road Segments That Are Not Under Study. Based on RDM Capacity Criteria. Table is sorted by "Year Congested" and then by "Current V/C Index." V/C indices are based on RDM capacity criteria.

Anticipated Congested Year Based on RDM: 2003											
Road	Current ADT	Current V/C Index	2010 ADT	2010 V/C Index	2020 ADT	2020 V/C Index	System Route	2003 LOS at Absolute Capacity	2010 LOS at Absolute Capacity	2020 LOS at Absolute Capacity	Lanes
Rainbow Rd (MC 85 to Southern Ave)	1,407	2.01	1,659	2.37	2,099	3	Secondary	A	A	A	2
051st Ave (Lower Buckeye Rd to Phoenix C/L)	18,051	1.94	14,462	1.55	22,940	2.46	Secondary	F	E	F	2
Thunderbird Blvd (Del Webb Blvd to Camelot Cir)	17,556	1.88	20,698	2.22	26,187	2.81	Secondary	F	F	F	2
Guadalupe Rd (Gilbert C/L to 172nd St)	13,523	1.45	13,825	1.48	17,764	1.91	Secondary	D	D	F	2
Broadway Rd (Phoenix C/L to 027th Ave)	12,158	1.3	20,149	2.16	28,607	3.07	Secondary	C	F	F	2
Litchfield Rd (Olive Ave to Peoria Ave)	9,033	1.23	7,265	0.99	6,584	0.9	Secondary	A	A	A	2
Maricopa Rd (Germann Rd Align to Hwy I-10)	13,994	1.14	10,416	0.85	26,158	2.12	Primary	D	B	F	2
Union Hills Dr (107th Ave to Welk Dr)	12,788	1.13	14,521	1.28	17,495	1.55	Secondary	D	E	F	2
Maricopa Rd (Queen Crk Rd Ali to Germann Rd Align)	13,656	1.11	8,227	0.67	20,176	1.64	Primary	D	A	F	2
Maricopa Rd (Queen Creek T I to Queen Crk Rd Ali)	13,656	1.11	8,227	0.67	20,176	1.64	Primary	D	A	F	2
103rd Ave (Prairie Hill Cir to Kingswood Cir)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
103rd Ave (Bolivar Dr to Floriade Dr)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
103rd Ave (Royal Oak Rd to Candlewood Dr)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
103rd Ave (Bellarose Dr to Lehigh Ct)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
103rd Ave (Bayside Rd to Bolivar Dr)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
103rd Ave (Cameo Dr to Prairie Hill Cir)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
103rd Ave (Kingswood Cir to Desert Frst Cir)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
103rd Ave (Desert Frst Cir to Bright Angel Cir)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
103rd Ave (Bright Angel Cir to Bellarose Dr)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
103rd Ave (Floriade Dr to Cameo Dr)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
103rd Ave (Candlewood Dr to Bayside Rd)	10,281	1.1	12,121	1.3	15,335	1.65	Secondary	B	C	E	2
Pecos Rd (Chandler C/L to Gilbert Rd)	9,066	1.09	6,288	0.76	22,308	2.68	Secondary	A	A	F	2
Union Hills Dr (Welk Dr to 104th Ave)	12,177	1.08	14,521	1.28	17,495	1.55	Secondary	C	E	F	2
Higley Rd (Williams Field Rd to Ray Rd)	8,915	1.07	8,268	0.99	13,002	1.56	Secondary	A	A	D	2
Boswell Blvd (Hutton Dr to Loma Blanca Dr)	7,579	1.04	8,935	1.22	11,305	1.54	Secondary	A	A	C	2
Bell Rd (Burns Dr to Peoria C/L)	50,788	1.04	40,893	0.84	36,802	0.75	Primary	C	B	A	6
Litchfield Rd (Northern Ave to Olive Ave)	7,466	1.02	7,950	1.09	12,014	1.64	Secondary	A	A	C	2
Boswell Blvd (Loma Blanca Dr to Campana Dr)	7,460	1.02	8,795	1.2	11,127	1.52	Secondary	A	A	C	2
Boswell Blvd (Kingswood Cir to Desert Frst Cir)	7,381	1.01	8,702	1.19	11,010	1.5	Secondary	A	A	C	2
Camino Del Sol (Ashwood Dr to 133rd Ave)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Bonanza Dr to Jadestone Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Jadestone Dr to La Terraza Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Mesa Verde Dr to Bonanza Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Keystone Dr to Mesa Verde Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Marble Dr to Keystone Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (133rd Ave to Bellwood Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Prospect Dr to Castle Rock Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Continuous to Prospect Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Copperstone Dr to Continuous)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Bellwood Dr to Marble Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Shadow Hills Dr to Ashwood Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2
Camino Del Sol (Castle Rock Dr to Shadow Hills Dr)	7,338	1	8,651	1.18	10,945	1.5	Secondary	A	A	B	2

Anticipated Congested Year Based on RDM: 2004											
Road	Current ADT	Current V/C Index	2010 ADT	2010 V/C Index	2020 ADT	2020 V/C Index	System Route	2003 LOS at Absolute Capacity	2010 LOS at Absolute Capacity	2020 LOS at Absolute Capacity	Lanes
Camino Del Sol (RH Johnson Blvd to Copperstone Dr)	7,139	0.98	8,417	1.15	10,649	1.46	Secondary	A	A	B	2
107th Ave (Willowbrook Dr to Manzanita Dr)	6,460	0.88	13,083	1.79	19,876	2.72	Secondary	A	D	F	2
107th Ave (Manzanita Dr to Garnette Dr)	6,460	0.88	13,083	1.79	19,876	2.72	Secondary	A	D	F	2
107th Ave (Garnette Dr to Union Hills Dr)	6,460	0.88	13,083	1.79	19,876	2.72	Secondary	A	D	F	2
107th Ave (Mimosa Dr to Willowbrook Dr)	6,460	0.88	13,083	1.79	19,876	2.72	Secondary	A	D	F	2
Pecos Rd (55'e/o Mc Queen Rd to Chandler C/L)	6,978	0.84	13,963	1.68	27,531	3.31	Secondary	A	D	F	2
107th Ave (Hibiscus Dr to Boswell Blvd)	6,091	0.83	13,492	1.84	24,469	3.34	Secondary	A	D	F	2
107th Ave (Welk Dr to Sequoia Dr)	6,091	0.83	13,492	1.84	24,469	3.34	Secondary	A	D	F	2
107th Ave (Sequoia Dr to Hibiscus Dr)	6,091	0.83	13,492	1.84	24,469	3.34	Secondary	A	D	F	2
107th Ave (Wheatridge Dr to Welk Dr)	6,091	0.83	13,492	1.84	24,469	3.34	Secondary	A	D	F	2
107th Ave (Boswell Blvd to Mimosa Dr)	5,911	0.81	13,083	1.79	19,876	2.72	Secondary	A	D	F	2
059th Ave (RID Canal to SR -85)	1,500	0.18	43,937	5.28	49,568	5.96	Secondary	A	F	F	2

Anticipated Congested Year Based on RDM: 2005											
Road	Current ADT	Current V/C Index	2010 ADT	2010 V/ C Index	2020 ADT	2020 V/ C Index	System Route	2003 LOS at Absolute Capacity	2010 LOS at Absolute Capacity	2020 LOS at Absolute Capacity	Lanes
107th Ave (Granada Dr to Del Webb Blvd)	6,968	0.95	8,215	1.12	10,394	1.42	Secondary	A	A	B	2
107th Ave (Del Webb Blvd to Wheatridge Dr)	5,440	0.74	13,492	1.84	24,469	3.34	Secondary	A	D	F	2
Queen Creek Rd (Chandler C/L to Gilbert Rd)	6,103	0.73	13,138	1.58	17,944	2.16	Primary	A	D	F	2
051st Ave (Grir Boundry to Estrella Dr)	5,891	0.63	19,495	2.09	23,698	2.54	Secondary	A	F	F	2
Happy Valley Rd (109th Ave to 107th Ave)	4,087	0.56	13,967	1.91	35,665	4.87	Secondary	A	D	F	2
Lower Buckeye Rd (End Of Maint to 051st Ave)	4,392	0.53	19,400	2.33	26,672	3.21	Secondary	A	F	F	2
Mc Queen Rd (Chandler C/L to Ocotillo Rd)	3,568	0.43	23,861	2.87	32,048	3.85	Secondary	A	F	F	2
Lower Buckeye Rd (067th Ave to 063rd Ave)	3,436	0.41	22,332	2.68	29,088	3.5	Secondary	A	F	F	2

Anticipated Congested Year Based on RDM: 2006											
Road	Current ADT	Current V/C Index	2010 ADT	2010 V/C Index	2020 ADT	2020 V/C Index	System Route	2003 LOS at Absolute Capacity	2010 LOS at Absolute Capacity	2020 LOS at Absolute Capacity	Lanes
Peoria Ave (103rd Ave to 099th Ave)	9,435	0.83	13,211	1.17	22,714	2.01	Secondary	B	D	F	2
051st Ave (Ray Rd to Grir Boundry)	5,891	0.71	11,961	1.44	10,022	1.2	Primary	A	C	B	2
051st Ave (South St Johns to Continuous)	5,891	0.71	11,961	1.44	10,022	1.2	Primary	A	C	B	2
051st Ave (Continuous to Ray Rd)	5,891	0.71	11,961	1.44	10,022	1.2	Primary	A	C	B	2
Mc Dowell Rd (Alma School Rd to Extension Rd)	16,055	0.67	32,353	1.34	32,742	1.36	Primary	A	E	E	4
Mc Queen Rd (Brooks Farm Rd to Chandler C/L)	3,670	0.44	14,979	1.8	14,781	1.78	Secondary	A	E	E	2
Cooper Rd (Willis Rd to Chandler C/L)	4,018	0.43	17,757	1.91	24,521	2.63	Secondary	A	F	F	2
Lower Buckeye Rd (071st Ave to 067th Ave)	3,436	0.41	16,179	1.95	31,835	3.83	Secondary	A	F	F	2
Mc Queen Rd (Chandler C/L to Brooks Farm Rd)	2,110	0.25	14,966	1.8	14,168	1.7	Secondary	A	E	E	2
Baseline Rd (067th Ave to Phoenix C/L)	2,032	0.24	15,597	1.88	22,042	2.65	Primary	A	E	F	2
Pioneer Rd (I 17 to Pioneer Dr)	1,181	0.14	19,040	2.29	17,402	2.09	Secondary	A	F	F	2
Lone Mtn Rd (056th St to 064th St)	254	0.03	16,476	1.98	24,145	2.9	Secondary	A	F	F	2

Anticipated Congested Year Based on RDM: 2007											
Road	Current ADT	Current V/C Index	2010 ADT	2010 V/C Index	2020 ADT	2020 V/C Index	System Route	2003 LOS at Absolute Capacity	2010 LOS at Absolute Capacity	2020 LOS at Absolute Capacity	Lanes
Mc Kellips Rd (Hayden Rd to SR 101)	22,122	0.69	37,859	1.18	36,627	1.14	Secondary	B	F	F	4
067th Ave (Pinnacle Peak Rd to Happy Valley Rd)	7,686	0.68	13,762	1.22	32,640	2.88	Secondary	A	D	F	2
Southern Ave (035th Ave to 027th Ave)	7,117	0.63	14,441	1.28	27,458	2.43	Secondary	A	E	F	2
Mc Dowell Rd (Extension Rd to Arizona Ave)	13,536	0.56	32,423	1.34	32,644	1.35	Primary	A	E	E	4
Usery Pass Rd (S.bdy Usery Park to Usery Park Rd)	4,593	0.55	10,845	1.3	13,407	1.61	Primary	A	B	D	2
Pecos Rd (Gilbert C/L to Lindsay Rd)	4,488	0.54	10,796	1.3	27,002	3.25	Secondary	A	B	F	2
Broadway Rd (075th Ave to 067th Ave)	3,986	0.48	12,218	1.47	19,045	2.29	Secondary	A	C	F	2
Van Buren St (107th Ave to 099th Ave)	4,489	0.48	13,033	1.4	23,217	2.49	Secondary	A	D	F	2
Mc Queen Rd (Cloud Dr to Chandler Hgts Rd)	3,836	0.46	11,732	1.41	11,375	1.37	Secondary	A	C	C	2
Lindsay Rd (Frye Rd Align to Buffalo St)	3,314	0.4	13,038	1.57	21,417	2.57	Secondary	A	D	F	2
Lindsay Rd (Buffalo St to Williams Field Rd)	3,314	0.4	13,038	1.57	21,417	2.57	Secondary	A	D	F	2
El Mirage Rd (Glendale Ave to Glendale C/L)	2,693	0.29	15,660	1.68	13,593	1.46	Secondary	A	E	D	2
Dynamite Blvd (048th St to 056th St)	1,700	0.2	13,289	1.6	31,077	3.74	Primary	A	D	F	2

Anticipated Congested Year Based on RDM: 2008											
Road	Current ADT	Current V/C Index	2010 ADT	2010 V/C Index	2020 ADT	2020 V/C Index	System Route	2003 LOS at Absolute Capacity	2010 LOS at Absolute Capacity	2020 LOS at Absolute Capacity	Lanes
103rd Ave (Lehigh Ct to Boswell Blvd)	8,252	0.89	9,729	1.04	12,309	1.32	Secondary	A	B	C	2
043rd Ave (Estrella Dr to Carver Rd)	622	0.89	733	1.05	928	1.33	Secondary	A	A	A	2
111th Ave (Kolina Ln to Peoria Ave)	5,639	0.61	10,398	1.12	10,803	1.16	Secondary	A	B	B	2
111th Ave (Cinnebar Ave to Cheryl Dr)	5,500	0.59	10,398	1.12	10,803	1.16	Secondary	A	B	B	2
111th Ave (Cheryl Dr to Cumberland Dr)	5,500	0.59	10,398	1.12	10,803	1.16	Secondary	A	B	B	2
111th Ave (Arron Cir to Deanne Dr)	5,500	0.59	10,398	1.12	10,803	1.16	Secondary	A	B	B	2
111th Ave (Tonada Dr to Caron Dr)	5,500	0.59	10,400	1.12	11,190	1.2	Secondary	A	B	C	2
111th Ave (Cumberland Dr to Camden Ave)	5,500	0.59	10,398	1.12	10,803	1.16	Secondary	A	B	B	2
111th Ave (Salem Dr to Cinnebar Ave)	5,500	0.59	10,398	1.12	10,803	1.16	Secondary	A	B	B	2
111th Ave (Mountain View Rd to Salem Dr)	5,500	0.59	10,398	1.12	10,803	1.16	Secondary	A	B	B	2
111th Ave (Venturi Dr to Mountain View Rd)	5,500	0.59	10,400	1.12	11,190	1.2	Secondary	A	B	C	2
111th Ave (Hatcher Rd to Venturi Dr)	5,500	0.59	10,400	1.12	11,190	1.2	Secondary	A	B	C	2
111th Ave (Kelso Dr to Hatcher Rd)	5,500	0.59	10,400	1.12	11,190	1.2	Secondary	A	B	C	2
111th Ave (Caron Dr to Continuous)	5,500	0.59	10,400	1.12	11,190	1.2	Secondary	A	B	C	2
111th Ave (Deanne Dr to Kolina Ln)	5,500	0.59	10,398	1.12	10,803	1.16	Secondary	A	B	B	2
111th Ave (Camden Ave to Arron Cir)	5,500	0.59	10,398	1.12	10,803	1.16	Secondary	A	B	B	2
Mc Dowell Rd (099th Ave to 091st Ave)	3,489	0.37	12,441	1.34	23,908	2.57	Secondary	A	C	F	2
Northern Ave (107th Ave to 099th Ave)	8,978	0.37	29,046	1.2	31,781	1.32	Secondary	A	D	E	4
Broadway Rd (055th Ave Align to 051st Ave)	2,520	0.3	10,607	1.28	30,219	3.63	Secondary	A	B	F	2
Alma School Rd (Spring Creek Rd to Michigan Ave)	1,948	0.21	11,947	1.28	14,389	1.54	Secondary	A	C	E	2
Alma School Rd (San Tan Blvd to Spring Creek Rd)	1,948	0.21	11,947	1.28	14,389	1.54	Secondary	A	C	E	2
Dynamite Blvd (040th St to 048th St)	1,617	0.19	11,518	1.38	27,508	3.31	Primary	A	C	F	2
Lone Mtn Rd (064th St to 068th St)	254	0.03	10,968	1.32	15,268	1.84	Secondary	A	C	E	2

Anticipated Congested Year Based on RDM: 2009											
Road	Current ADT	Current V/C Index	2010 ADT	2010 V/C Index	2020 ADT	2020 V/C Index	System Route	2003 LOS at Absolute Capacity	2010 LOS at Absolute Capacity	2020 LOS at Absolute Capacity	Lanes
Thunderbird Blvd (099th Ave to 098th Ave)	23,069	0.96	24,261	1.01	26,794	1.11	Secondary	B	B	C	4
Rittenhouse Rd (Power Rd to Sossaman Rd)	9,578	0.78	12,962	1.05	11,360	0.92	Secondary	B	D	C	2
Thunderbird Blvd (103rd Ave to Royal Oak Rd)	20,328	0.78	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Redwood Dr to Teakwood Dr)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Teakwood Dr to Lancaster Dr)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Hawthorn Dr to Redwood Dr)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Royal Oak Rd to Candlewood Dr)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Emberwood Dr to Hawthorn Dr)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Lancaster Dr to 099th Dr)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (099th Dr to Tumblebrook Wy)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Cedar Dr to Forrester Dr)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Cedar Dr to Cedar Dr)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Candlewood Dr to Cedar Dr)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Forrester Dr to Emberwood Dr)	17,757	0.68	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
Thunderbird Blvd (Tumblebrook Wy to 099th Ave)	16,804	0.64	27,236	1.04	25,192	0.96	Secondary	A	C	C	4
051st Ave (Estrella Dr to Elliot Rd)	5,891	0.63	9,857	1.06	13,878	1.49	Secondary	A	B	D	2
Ray Rd (Gilbert C/L to 162nd St Align)	4,271	0.51	9,120	1.1	17,413	2.09	Secondary	A	A	F	2
Ray Rd (162nd St Align to Higley Rd)	4,271	0.51	8,806	1.06	17,398	2.09	Secondary	A	A	F	2
Southern Ave (043rd Ave to Phoenix C/L)	5,517	0.49	11,794	1.04	26,759	2.36	Secondary	A	C	F	2
111th Ave (Olive Ave to Tonada Dr)	4,483	0.48	10,400	1.12	11,190	1.2	Secondary	A	B	C	2
Broadway Rd (067th Ave to 063rd Ave Align)	3,347	0.4	9,421	1.13	17,365	2.09	Secondary	A	B	F	2
Broadway Rd (059th Ave to Phoenix C/L)	3,347	0.4	9,103	1.09	29,877	3.59	Secondary	A	A	F	2
Lower Buckeye Rd (El Mirage Rd to 115th Ave)	3,002	0.32	9,988	1.07	25,025	2.69	Secondary	A	B	F	2
Baseline Rd (Phoenix C/L to 067th Ave)	2,032	0.24	9,087	1.09	14,494	1.74	Primary	A	A	E	2
Baseline Rd (091st Ave to 083rd Ave)	1,911	0.23	9,087	1.09	15,707	1.89	Primary	A	A	F	2
091st Ave (Baseline Rd to Phoenix C/L)	1,806	0.22	9,087	1.09	15,707	1.89	Secondary	A	A	F	2
Greenfield Rd (Eastern Canal to Gilbert C/L)	2,009	0.22	10,645	1.14	13,443	1.44	Secondary	A	B	D	2
091st Ave (Phoenix C/L to Broadway Rd)	1,737	0.21	9,087	1.09	1,969	0.24	Secondary	A	A	A	2
Yuma Rd (Cotton Ln to Sarival Ave)	1,856	0.2	10,898	1.17	22,560	2.42	Secondary	A	B	F	2
Broadway Rd (Phoenix C/L to 091st Ave)	1,539	0.19	10,086	1.21	10,512	1.26	Secondary	A	B	B	2
Baseline Rd (083rd Ave to GRIR Boundry)	860	0.1	9,087	1.09	15,707	1.89	Primary	A	A	F	2

Anticipated Congested Year Based on RDM: 2010											
Road	Current ADT	Current V/C Index	2010 ADT	2010 V/C Index	2020 ADT	2020 V/C Index	System Route	2003 LOS at Absolute Capacity	2010 LOS at Absolute Capacity	2020 LOS at Absolute Capacity	Lanes
Boswell Blvd (Bell Rd to Palmeras Dr)	6,296	0.86	7,423	1.01	9,391	1.28	Secondary	A	A	B	2
Thunderbird Blvd (Sahara Dr to Boswell Blvd)	20,844	0.86	24,261	1.01	26,794	1.11	Secondary	B	B	C	4
Thunderbird Blvd (098th Ave to Sahara Dr)	20,844	0.86	24,261	1.01	26,794	1.11	Secondary	B	B	C	4
Thunderbird Blvd (Boswell Blvd to Peoria C/L)	20,844	0.86	24,261	1.01	26,794	1.11	Secondary	B	B	C	4
Rittenhouse Rd (Sossaman Rd to Ryan Rd Align)	9,235	0.75	12,397	1.01	15,128	1.23	Secondary	A	C	E	2
Recker Rd (Houston Ave to Gilbert C/L)	5,932	0.64	8,843	0.95	20,822	2.23	Secondary	A	A	F	2
Val Vista Dr (Germann Rd to Willis Rd)	5,058	0.61	8,351	1	13,547	1.63	Secondary	A	A	D	2
Southern Ave (051st Ave to 043rd Ave)	3,942	0.35	10,697	0.95	23,811	2.1	Secondary	A	B	F	2
Indian School Rd (Sarival Ave to Reems Rd)	3,083	0.33	9,393	1.01	20,612	2.21	Secondary	A	B	F	2
Alma School Rd (Mc Kellips Rd to Mcdowell Rd)	7,741	0.24	32,635	1.02	33,341	1.04	Secondary	A	E	E	4
Dean Rd (Buckeye C/L to Yuma Rd)	718	0.1	7,079	0.97	16,756	2.29	Secondary	A	A	F	2
067th Ave (Happy Valley Rd to Phoenix C/L)	777	0.09	8,579	1.03	21,652	2.6	Secondary	A	A	F	2
Lower Buckeye Rd (115th Ave to 107th Ave)	492	0.05	9,051	0.97	22,101	2.37	Secondary	A	A	F	2

Table 9: Current and Projected Congested Road Segments That Are Currently Under Study.
Table is sorted by "Year Congested" and then by "Current V/C Index." V/C indices are based on RDM capacity criteria.

Road	Status	Current ADT	Current V/C Index	2010 ADT	2010 V/C Index	2020 ADT	2020 V/C Index	System Route	2003 LOS at Absolute Capacity	2010 LOS at Absolute Capacity	2020 LOS at Absolute Capacity	Lanes
Anticipated Congested Year Based on RDM: 2003												
Gilbert Rd (Pecos Rd to Williams Field Rd)	DCR	15,259	2.09	9,992	1.37	19,433	2.66	Primary	E	B	F	2
Higley Rd (Houston Ave to Gilbert C/L)	Prelim	14,838	1.59	31,981	3.43	33,041	3.55	Secondary	E	F	F	2
Power Rd (Germann Rd to Rittenhouse Rd)	Prelim	11,609	1.4	7,270	0.87	16,272	1.96	Primary	C	A	F	2
Indian School Rd (Indian School Ln to Dysart Rd)	Prelim	10,945	1.17	18,569	1.99	27,951	3	Secondary	B	F	F	2
075th Ave (MC 85 to Van Buren St)	Design	10,661	1.14	10,268	1.1	21,822	2.34	Secondary	B	B	F	2
Gilbert Rd (Gilbert C/L to Galveston St)	Prelim	9,378	1.13	23,324	2.8	34,969	4.2	Primary	A	F	F	2
El Mirage Rd (Union Hills Alig to Beardsley Rd)	Design	9,847	1.06	9,961	1.07	18,696	2.01	Secondary	B	B	F	2
El Mirage Rd (Bell Rd to Union Hills Alig)	Design	9,658	1.04	9,961	1.07	22,551	2.42	Secondary	B	B	F	2
Gilbert Rd (Galveston St to Shannon St)	Prelim	9,378	1.01	23,962	2.57	34,915	3.75	Primary	A	F	F	2
083rd Ave (Northern Ave to Olive Ave)	Design	11,177	0.99	17,826	1.58	25,684	2.27	Secondary	C	F	F	2
Higley Rd (Ray Rd to Warner Rd)	Prelim	8,122	0.98	14,637	1.76	24,071	2.89	Secondary	A	E	F	2

Road	Status	Current ADT	Current V/C Index	2010 ADT	2010 V/C Index	2020 ADT	2020 V/C Index	System Route	2003 LOS at Absolute Capacity	2010 LOS at Absolute Capacity	2020 LOS at Absolute Capacity	Lanes
Anticipated Congested Year Based on RDM: 2004												
083rd Ave (Peoria C/L to Pinnacle Peak Rd)	Prelim	9,905	0.88	17,084	1.51	25,049	2.21	Secondary	B	F	F	2
Estrella Frwy (Waddell Rd to Greenway Rd)	DCR	6,358	0.76	15,716	1.89	28,814	3.46	Primary	A	F	F	2
Gilbert Rd (Germann Rd to Pecos Rd)	Prelim	5,233	0.72	25,489	3.48	49,722	6.79	Primary	A	F	F	2
Gilbert Rd (Ryan Rd Align to Germann Rd)	Prelim	4,707	0.57	21,925	2.64	36,129	4.34	Primary	A	F	F	2

Anticipated Congested Year Based on RDM: 2006												
Road	**Status**	**Current ADT**	**Current V/C Index**	**2010 ADT**	**2010 V/C Index**	**2020 ADT**	**2020 V/C Index**	**System Route**	**2003 LOS at Absolute Capacity**	**2010 LOS at Absolute Capacity**	**2020 LOS at Absolute Capacity**	**Lanes**
Estrella Frwy (Beardsley Rd Alin to Grand Ave)	DCR	6,047	0.73	12,262	1.47	21,251	2.55	Primary	A	C	F	2
Estrella Frwy (Northern Ave to Olive Ave)	DCR	4,906	0.59	14,351	1.73	31,991	3.85	Primary	A	E	F	2
Estrella Frwy (Glendale Ave to Northern Ave)	DCR	4,439	0.53	13,724	1.65	30,661	3.69	Primary	A	D	F	2
Estrella Frwy (Bethany Home Rd to Glendale Ave)	DCR	3,771	0.45	14,391	1.73	31,412	3.78	Primary	A	E	F	2
Estrella Frwy (Indian School Rd to Camelback Rd)	DCR	3,771	0.45	14,962	1.8	31,765	3.82	Primary	A	E	F	2
099th Ave (Adot Loop 101 to Northern Ave)	Prelim	2,875	0.25	19,980	1.77	23,209	2.05	Secondary	A	F	F	2

Anticipated Congested Year Based on RDM: 2007												
Road	**Status**	**Current ADT**	**Current V/C Index**	**2010 ADT**	**2010 V/C Index**	**2020 ADT**	**2020 V/C Index**	**System Route**	**2003 LOS at Absolute Capacity**	**2010 LOS at Absolute Capacity**	**2020 LOS at Absolute Capacity**	**Lanes**
Mc Dowell Rd (Sossaman Rd to Hawes Rd)	Prelim	7,115	0.76	11,429	1.23	8,676	0.93	Secondary	A	C	A	2
Estrella Frwy (Union Hills Dr to Beardsley Rd Align)	DCR	6,047	0.73	10,163	1.22	21,251	2.55	Primary	A	B	F	2
Miller Rd (Lower Buckeye Rd to I-10 Frontage Rd)	Prelim	5,408	0.58	11,629	1.25	28,529	3.06	Secondary	A	C	F	2
Pinnacle Peak Rd (Peoria C/L to 091st Ave)	DCR	4,042	0.55	9,708	1.33	11,696	1.6	Secondary	A	B	C	2
099th Ave (Glendale C/L to ADOT Loop 101)	DCR	1,800	0.16	19,980	1.77	22,004	1.94	Secondary	A	F	F	2

Anticipated Congested Year Based on RDM: 2008												
Road	**Status**	**Current ADT**	**Current V/C Index**	**2010 ADT**	**2010 V/C Index**	**2020 ADT**	**2020 V/C Index**	**System Route**	**2003 LOS at Absolute Capacity**	**2010 LOS at Absolute Capacity**	**2020 LOS at Absolute Capacity**	**Lanes**
Brown Rd (Signal Butte Rd to Meridian Rd)	Prelim	7,635	0.82	9,743	1.05	10,724	1.15	Secondary	A	B	B	2

Anticipated Congested Year Based on RDM: 2010												
Road	**Status**	**Current ADT**	**Current V/C Index**	**2010 ADT**	**2010 V/C Index**	**2020 ADT**	**2020 V/C Index**	**System Route**	**2003 LOS at Absolute Capacity**	**2010 LOS at Absolute Capacity**	**2020 LOS at Absolute Capacity**	**Lanes**
115th Ave (Avondale C/L to Mc Dowell Rd)	Design	9,134	0.98	8,926	0.96	17,765	1.91	Primary	A	A	F	2
Miller Rd (Broadway Rd to Lower Buckeye Rd)	Prelim	5,324	0.57	9,092	0.98	18,015	1.93	Secondary	A	A	F	2
Val Vista Dr (Southern Canal to Thomas Rd)	Design	1,206	0.11	11,779	1.04	6,790	0.6	Secondary	A	C	A	2
Southern Ave (Signal Butte Rd to Meridian Rd)	Prelim	400	0.04	11,839	1.05	13,204	1.17	Secondary	A	C	D	2

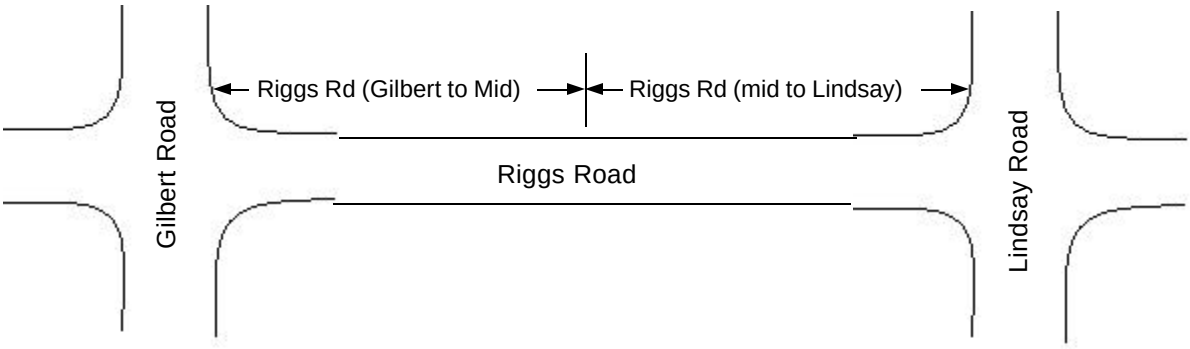
INTERSECTION ANALYSIS

An analysis of traffic congestion at intersections was performed, in addition to roadway segment congestion analysis. Intersection capacities were calculated using modified Highway Capacity Manual (HCM) methods and revised to accommodate larger scale analysis. These capacities should be considered much more accurate than RDM or absolute capacity methods since they account for the traffic control devices and intersection configuration. The modified HCM methods user here are described in the Highway Performance Monitoring System (HPMS) Field Manual that was developed by the U.S. Department of Transportation.

Intersection Analysis Methods

Intersections were first identified by splitting the MCDOT RPCA road segments in half and then combining each of the half segments (or legs) into their corresponding intersections. Since the HPMS method is designed for only arterial and collector roads, only the 2,450 arterial and collector segments owned by MCDOT were analyzed. Half segments that did not have termini at intersections (those with termini named "continuous", ending at city limits, etc.) were removed from the analysis. Intersection legs were renamed based on the following example:

Original Segment Name:	Riggs Rd (Gilbert Rd to Lindsay Rd)
New Intersection Leg Names:	Riggs Rd (Gilbert to mid)
	Riggs Rd (mid to Lindsay Rd)



Two potential intersection legs were therefore made from each road segment with the word "mid" used to indicate the break-point in the original segment.

Each intersection leg was assigned an average daily traffic (ADT) volume from MCDOT traffic counts, MCDOT Roadway Management System (RMS) interpolated volumes, or average traffic volumes based on the roads' functional classification. The average traffic volumes are the calculated average of all traffic volumes, for each functional classification, provided in the traffic counts and RMS. Actual traffic counts were used whenever they were available while average volumes were used only when traffic counts and RDM volumes were not available. Peak-hour traffic vol-

umes (traffic volumes during the busiest hour of the day) were calculated for each intersection leg using the HPMS method. Thus, the resulting intersection V/C ratios consist of peak hour traffic volumes divided by the intersection leg capacity.

Intersection Analysis Results

Tables 10 and 11 show the intersections where at least one leg is or expected be congested by the year 2010. The tables indicate:

1. Year At Least One Leg Congested: The year the first leg of the intersection is expected to become congested
2. Intersection: the names of the cross streets of the intersection.
3. Average V/C: The average 2003, 2010 and 2020 v/c for all legs of the intersection that were analyzed.
4. Congested Legs: The number of analyzed intersection legs that are currently congested.
5. Leg Name: The name of each leg of the intersection.
6. Control: The traffic control device controlling the intersection leg.
7. Lanes (T/L/R): The number of through (T), left-turn (L), and right-turn (R) lanes on the intersection leg.
8. Peak Lane Volume: The calculated traffic volume for the peak-hour on the intersection leg.
9. Peak Lane Capacity: The calculated traffic capacity for the intersection leg.
10. V/C: the 2003, 2010, and 2020 volume-to-capacity ratios for the intersection leg.
11. Year Congested: The year the intersection leg is expected to become congested (a blank cell indicates congestion on or before the year 2020)
12. ADT Type: “A” indicates the traffic volume is from a MCDOT traffic count or an RMS interpolated volume. “E” indicates an estimated volume which is the average traffic volume based on the intersection leg’s functional classification.

Table 10 shows there are 21 intersections not currently being studied that have at least one congested leg (V/C greater than 1.00) and 34 additional unstudied intersections that may experience congestion problems by the year 2010. Table 11 indicates there are 10 intersections that are currently being studied that have at least one congested leg and 12 additional intersections that are under study that may experience congestion problems by the year 2010. Bear in mind that not all the legs of each intersection are shown. Legs, which are primarily in other jurisdictions, may also be congested.

Several of the intersections shown in Tables 10 and 11 may correspond to segments shown in Tables 8 and 9. Tables 10 and 11 are therefore supplementary to the segment analysis and congested intersections should not be considered in addition to the segments indicated in Tables 8 and 9. The results should also be more thoroughly investigated before making decisions to expend funds to correct these congested intersections. The results are based on the best data available, but may still contain errors. Options to mitigate intersections may include revising the signal timing or changing the traffic control device before adding additional lanes.

Table 10: Current and Projected Congested Intersections that are not currently under study. Sorted by "Year Congested and Avg V/C. Based on HCM.

Intersection	Average V/C	Average 2010 V/C	Average 2020 V/C	Con-gested Legs	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capacity	V/C	2010 V/C	2020 V/C	Year Con-gested	ADT Type (A=Actual, E=Estimate)
Year At least One Leg Congested: 2003														
098TH AVE / BELL RD	1.88	1.6	1.63	2	098TH AVE to mid	Signal	3/1/0	878	532	1.7	1.3	1.36	2003	A
					mid to 098TH AVE	Signal	3/1/0	801	380	2.1	1.9	1.9	2003	A
099TH AVE / BELL RD	1.64	1.54	1.69	2	099TH AVE to mid	Signal	3/2/0	801	380	2.1	1.9	1.9	2003	A
					BELL RD to mid	Signal	2/2/0	380	438	0.9	1	1.39	2007	A
					mid to 099TH AVE	Signal	3/2/0	867	324	2.7	2.3	2.2	2003	A
					mid to BELL RD	Signal	2/2/0	401	438	0.9	1	1.27	2007	A
114TH AVE / BELL RD	1.42	1.63	1.63	1	115TH AVE to mid	Signal	3/1/0	768	542	1.4	1.6	1.63	2003	A
BELL RD / BOSWELL BLVD	1.36	1.41	1.51	2	BELL RD to mid	Signal	1/0/0	365	380	1	1.3	1.58	2003	A
					mid to BOSWELL BLVD	Signal	3/1/0	768	698	1.1	1	1.02	2003	A
					BOSWELL BLVD to mid	Signal	3/1/0	867	324	2.7	2.3	2.2	2003	A
					mid to BELL RD	Signal	1/1/0	303	433	0.7	1	1.22	2009	A
BELL RD / BURNS DR	1.32	1.11	1.11	2	BURNS DR to mid	Signal	3/1/0	982	558	1.8	1.4	1.28	2003	A
					mid to BELL RD	Signal	1/1/0	264	483	0.6	0.6	0.68		A
					mid to BURNS DR	Signal	3/1/0	878	532	1.7	1.3	1.36	2003	A
BELL RD / DEL WEBB BLVD	1.21	1.36	1.62	3	mid to DEL WEBB BLVD	Signal	3/2/0	768	542	1.4	1.6	1.63	2003	A
					BELL RD to mid	Signal	2/2/0	337	404	0.8	1	1.76	2010	A
					DEL WEBB BLVD to mid	Signal	3/2/0	879	564	1.6	1.3	1.2	2003	A
					mid to BELL RD	Signal	2/2/0	398	385	1	1.5	1.89	2003	A
GRANITE VALLEY DR / MEEKER BLVD	1.12	0.62	1.52	3	mid to GRANITE VALLEY D	Stop	3/1/0	218	200	1.1	0.7	1.99	2003	A
					MEEKER BLVD to mid	Stop	1/0/0	507	475	1.1	0.3	0.4	2003	A
					GRANITE VALLEY D to mid	Stop	3/0/0	218	183	1.2	0.8	2.17	2003	A
107TH AVE / DEL WEBB BLVD	1.1	1.33	2.25	2	107TH AVE to mid	Stop	2/1/0	431	300	1.4	1.3	2.36	2003	A
					DEL WEBB BLVD to mid	Stop	1/0/0	316	475	0.7	1.7	2.99	2004	A
					mid to 107TH AVE	Stop	2/1/0	431	300	1.4	1.3	2.36	2003	A
					mid to DEL WEBB BLVD	Stop	1/0/0	404	475	0.9	1.1	1.28	2007	A
107TH AVE / UNION HILLS DR	1.09	1.45	1.97	1	107TH AVE to mid	Stop	2/0/0	371	275	1.4	1.5	1.85	2003	A
					mid to UNION HILLS DR	Stop	2/0/0	228	275	0.8	1.4	2.09	2004	A
ALEPPO DR / MEEKER BLVD	1.09	0.72	1.99	2	ALEPPO DR to mid	Stop	3/1/0	218	200	1.1	0.7	1.99	2003	A
					mid to ALEPPO DR	Stop	3/1/0	218	200	1.1	0.7	1.99	2003	A

Intersection	Average V/C	Average 2010 V/C	Average 2020 V/C	Congested Legs	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capacity	V/C	2010 V/C	2020 V/C	Year Congested	ADT Type (A=Actual, E=Estimate)
051ST AVE / LOWER BUCKEYE RD	1.05	1.25	1.88	1	mid to 051ST AVE	Signal	1/1/1	255	1,128	0.2	1	1.37	2009	A
					LOWER BUCKEYE RD to mid	Signal	1/1/0	1,047	556	1.9	1.5	2.39	2003	A
CAMINO DEL SOL / MEEKER BLVD	0.94	0.64	1.61	2	CAMINO DEL SOL to mid	Stop	2/1/0	327	300	1.1	0.4	1.9	2003	A
					MEEKER BLVD to mid	Stop	2/1/1	221	350	0.6	0.8	0.95		A
					mid to CAMINO DEL SOL	Stop	2/1/0	327	300	1.1	0.7	1.99	2003	A
091ST AVE / NORTHERN AVE	0.88	1.02	1.88	1	mid to NORTHERN AVE	Signal	2/1/0	481	423	1.1	0.6	1.76	2003	A
					091ST AVE to mid	Signal	2/0/0	282	356	0.8	1.4	2.13	2005	E
					mid to 091ST AVE	Signal	2/1/0	277	396	0.7	1.1	1.74	2007	A
099TH AVE / THUNDERBIRD BLVD	0.87	1.26	1.29	2	mid to THUNDERBIRD BLVD	Signal	2/2/1	293	732	0.4	0.9	0.91		A
					THUNDERBIRD BLVD to mid	Signal	2/2/0	543	472	1.2	1.5	1.63	2003	A
					099TH AVE to mid	Signal	2/1/1	669	756	0.9	0.9	1.03	2017	A
					mid to 099TH AVE	Signal	2/1/0	487	460	1.1	1.7	1.59	2003	A
107TH AVE / OLIVE AVE	0.85	0.75	1.09	1	107TH AVE to mid	Signal	2/1/0	722	628	1.2	0.8	1.12	2003	A
					mid to 107TH AVE	Signal	2/1/0	521	628	0.8	0.8	1.28	2015	A
					OLIVE AVE to mid	Signal	1/1/0	242	424	0.6	0.7	0.87		A
BROADWAY RD / ELLSWORTH RD	0.82	0.66	0.85	1	mid to BROADWAY RD	Signal	2/1/1	434	696	0.6	0.6	0.83		A
					mid to ELLSWORTH RD	Signal	2/1/0	311	749	0.4	0.7	0.8		A
					ELLSWORTH RD to mid	Signal	2/1/0	363	558	0.7	0.7	0.7		A
					BROADWAY RD to mid	Signal	2/1/0	635	396	1.6	0.7	1.08	2003	A

Intersection	Average V/C	Average 2010 V/C	Average 2020 V/C	Congested Legs	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capacity	V/C	2010 V/C	2020 V/C	Year Congested	ADT Type (A=Actual, E=Estimate)
RECKER RD / UNIVERSITY DR	0.8	0.64	0.91	1	mid to UNIVERSITY DR	Signal	2/1/0	341	580	0.6	0.7	0.85		A
					RECKER RD to mid	Signal	2/1/0	570	596	1	0.5	0.93		A
					UNIVERSITY DR to mid	Signal	2/1/0	338	580	0.6	0.8	0.93		A
					mid to RECKER RD	Signal	2/1/0	602	568	1.1	0.6	0.91	2003	A
CAMINO DEL SOL / SPANISH GARDEN DR	0.76	0.76	0.91	1	CAMINO DEL SOL to mid	Stop	1/0/0	134	475	0.3	0.4	0.42		A
					mid to SPANISH GARDEN D	Stop	2/1/0	221	300	0.7	0.9	1.1	2014	A
					SPANISH GARDEN D to mid	Stop	2/1/0	374	300	1.3	1	1.2	2003	A
103RD AVE / THUNDERBIRD BLVD	0.66	0.83	0.96	0	mid to 103RD AVE	Signal	2/1/0	418	602	0.7	0.9	0.99		A
					mid to THUNDERBIRD BLVD	Signal	2/0/0	282	474	0.6	0.4	0.73		A
					103RD AVE to mid	Signal	2/1/0	590	602	1	1.3	1.21	2003	A
					THUNDERBIRD BLVD to mid	Signal	2/0/0	189	491	0.4	0.8	0.91		A
ELLSWORTH RD / SOUTHERN AVE	0.59	0.58	0.88	1	mid to ELLSWORTH RD	Signal	2/1/0	102	1,460	0.1	0.1	0.18		A
					mid to SOUTHERN AVE	Signal	2/1/0	434	396	1.1	1.1	1.64	2003	A
					SOUTHERN AVE to mid	Signal	2/1/1	434	696	0.6	0.6	0.83		A
EL MIRAGE RD / OLIVE AVE	0.44	0.83	1.46	1	OLIVE AVE to mid	Stop	1/1/0	87	525	0.2	0.2	0.25		A
					EL MIRAGE RD to mid	Stop	2/1/0	349	300	1.2	1.9	3.02	2003	A
					mid to EL MIRAGE RD	Stop	2/1/0	73	300	0.2	1	2.34	2009	A
					mid to OLIVE AVE	Stop	1/1/0	87	525	0.2	0.2	0.25		A

Intersection	Average V/C	Average 2010 V/C	Average 2020 V/C	Congested Legs	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capacity	V/C	2010 V/C	2020 V/C	Year Congested	ADT Type (A=Actual, E=Estimate)
099TH AVE / BOSWELL BLVD	0.68	0.93	1.07	0	mid to BOSWELL BLVD	Signal	2/1/0	500	748	0.7	0.9	1.03	2017	A
					mid to 099TH AVE	Signal	1/1/0	173	314	0.6	0.7	0.83		A
					099TH AVE to mid	Signal	1/0/0	171	299	0.6	0.7	0.84		A
					BOSWELL BLVD to mid	Signal	2/1/0	452	486	0.9	1.4	1.59	2003	A
099TH AVE / GREENWAY RD	0.62	0.79	0.92	0	099TH AVE to mid	Signal	1/1/0	292	677	0.4	0.4	0.44		A
					GREENWAY RD to mid	Signal	2/1/1	373	753	0.5	0.6	0.74		A
					mid to GREENWAY RD	Signal	2/1/0	452	486	0.9	1.4	1.59	2003	A
067TH AVE / HAPPY VALLEY RD	0.49	1.05	2.54	0	HAPPY VALLEY RD to mid	Stop	1/0/1	45	1,146	0	0.4	1.09	2019	A
					mid to HAPPY VALLEY RD	Stop	1/0/0	446	475	0.9	1.7	3.99	2003	A
107TH AVE / BOSWELL BLVD	0.47	0.91	1.47	0	mid to BOSWELL BLVD	Stop	1/0/0	425	475	0.9	1.7	2.99	2003	A
					107TH AVE to mid	Stop	1/0/0	69	475	0.2	0.2	0.22		A
					mid to 107TH AVE	Stop	1/0/0	64	475	0.1	0.2	0.24		A
					BOSWELL BLVD to mid	Stop	1/0/0	343	475	0.7	1.6	2.43	2004	A

Year At least One Leg Congested: 2004														
Intersection	Average V/C	Average 2010 V/C	Average 2020 V/C	Congested Legs	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capacity	V/C	2010 V/C	2020 V/C	Year Congested	ADT Type (A=Actual, E=Estimate)
107TH AVE / INDIAN SCHOOL RD	0.55	1.65	1.77	0	107TH AVE to mid	Signal	2/1/0	103	242	0.4	2.3	2.71	2004	E
					mid to 107TH AVE	Signal	2/1/0	444	664	0.7	1	0.83	2008	A
107TH AVE / NORTHERN AVE	0.44	1.95	2.2	0	107TH AVE to mid	Stop	1/1/1	219	625	0.4	2.7	2.95	2004	A
					mid to 107TH AVE	Stop	1/1/0	551	1,050	0.5	1.2	1.44	2007	A
027TH AVE / SOUTHERN AVE	0.36	1.02	1.63	0	SOUTHERN AVE to mid	Stop	1/0/0	58	475	0.1	0.9	1.14	2014	A
					mid to 027TH AVE	Stop	1/1/0	413	525	0.8	1.6	3.04	2004	A
					mid to SOUTHERN AVE	Stop	1/0/0	77	475	0.2	0.6	0.7		A

Year At least One Leg Congested: 2005														
Intersection	Average V/C	Average 2010 V/C	Average 2020 V/C	Congested Legs	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capacity	V/C	2010 V/C	2020 V/C	Year Congested	ADT Type (A=Actual, E=Estimate)
RH JOHNSON BLVD / WHISPING OAK DR	0.75	1.26	1.35	0	mid to WHISPING OAK DR	Signal	3/1/0	425	523	0.8	1.3	1.33	2005	A
					WHISPING OAK DR to mid	Signal	3/1/0	347	512	0.7	1.3	1.36	2006	A
043RD AVE / SOUTHERN AVE	0.47	1.03	2.2	0	043RD AVE to mid	Stop	1/0/0	320	475	0.7	1.4	3.27	2005	A
					mid to 043RD AVE	Stop	1/0/0	229	475	0.5	1.3	2.91	2006	A
					SOUTHERN AVE to mid	Stop	1/0/0	128	475	0.3	0.3	0.41		A
091ST AVE / MC DOWELL RD	0.47	1.22	2.14	0	091ST AVE to mid	Signal	2/1/0	329	390	0.8	1.2	1.8	2006	A
				0	mid to 091ST AVE	Signal	1/1/0	207	440	0.5	1.6	3.15	2005	E
				0	mid to MC DOWELL RD	Signal	2/1/0	65	594	0.1	0.9	1.47	2012	A
059TH AVE / MC-85	0.08	2.35	2.65	0	mid to MC-85	Signal	1/1/0	87	1,083	0.1	2.4	2.65	2005	A

Year At least One Leg Congested: 2006														
Intersection	**Aver-age V/C**	**Aver-age 2010 V/C**	**Aver-age 2020 V/C**	**Con-gested Legs**	**Leg Name**	**Con-trol**	**Lanes (T/L/R)**	**Peak Lane Vol-ume**	**Peak Lane Ca-pacity**	**V/C**	**2010 V/C**	**2020 V/C**	**Year Con-gested**	**ADT Type (A=Actual, E=Estimate)**
DEL WEBB BLVD / THUNDERBIRD BLVD	0.55	1.01	1.2	0	THUNDERBIRD BLVD to mid	Signal	2/1/0	401	581	0.7	1.2	1.42	2006	A
					mid to THUNDERBIRD BLVD	Signal	2/1/0	404	581	0.7	1.2	1.42	2006	A
					mid to DEL WEBB BLVD	Signal	2/1/0	91	424	0.2	1	1.26	2011	A
					DEL WEBB BLVD to mid	Signal	2/1/0	509	862	0.6	0.6	0.69		A
107TH AVE / VAN BUREN ST	0.5	0.86	2.21	0	107TH AVE to mid	Stop	1/1/0	260	525	0.5	1.4	2.56	2006	A
					mid to 107TH AVE	Stop	1/1/0	356	525	0.7	0.9	2.41	2011	A
					mid to VAN BUREN ST	Stop	1/1/0	201	525	0.4	0.2	1.61	2016	A
					VAN BUREN ST to mid	Stop	1/1/0	229	525	0.4	0.9	2.27	2010	A
135TH AVE / MEEKER BLVD	0.49	0.39	0.46	0	MEEKER BLVD to mid	Signal	1/1/0	353	487	0.7	0	0.02		E
					mid to 135TH AVE	Signal	2/1/0	64	688	0.1	0.1	0.14		E
					135TH AVE to mid	Signal	1/1/0	623	723	0.9	1.1	1.29	2006	A
					mid to MEEKER BLVD	Signal	1/0/0	128	466	0.3	0.3	0.41		A
BULLARD AVE / MC DOWELL RD	0.44	1.42	2.23	0	MC DOWELL RD to mid	Stop	1/0/0	207	475	0.4	1.4	2.23	2006	E

Year At least One Leg Congested: 2007														
Intersection	Aver-age V/C	Aver-age 2010 V/C	Aver-age 2020 V/C	Con-gested Legs	Leg Name	Con-trol	Lanes (T/L/R)	Peak Lane Vol-ume	Peak Lane Ca-pacity	V/C	2010 V/C	2020 V/C	Year Con-gested	ADT Type (A=Actual, E=Estimate)
EL MIRAGE RD / NORTHERN AVE	0.66	0.72	1.39	0	EL MIRAGE RD to mid	Stop	1/0/0	447	475	0.9	1	2.39	2007	A
					mid to EL MIRAGE RD	Stop	1/0/0	403	475	0.9	0.9	1.52	2011	A
					NORTHERN AVE to mid	Stop	1/0/0	87	475	0.2	0.2	0.27		A
035TH AVE / SOUTH-ERN AVE	0.51	0.99	2.02	0	035TH AVE to mid	Signal	1/1/0	413	689	0.6	1.2	2.31	2007	A
					mid to 035TH AVE	Signal	1/1/0	229	689	0.3	0.9	2.02	2011	A
					mid to SOUTHERN AVE	Signal	1/1/0	332	562	0.6	0.9	1.73	2012	A
DOBSON RD / RIGGS RD	0.44	0.87	1.19	0	mid to DOBSON RD	Signal	2/1/0	448	793	0.6	1	1.4	2011	A
					DOBSON RD to mid	Signal	2/1/0	443	658	0.7	1.1	1.66	2007	A
					mid to RIGGS RD	Signal	2/1/0	32	309	0.1	0.6	0.52		A
103RD AVE / OLIVE AVE	0.39	1.26	2.53	0	OLIVE AVE to mid	Signal	2/1/0	97	250	0.4	1.3	2.53	2007	A
EL MIRAGE RD / LOWER BUCKEYE RD	0.34	0.81	1.8	0	EL MIRAGE RD to mid	Stop	1/0/0	174	475	0.4	1.2	3.05	2007	A
					LOWER BUCKEYE RD to mid	Stop	1/0/0	171	475	0.4	0.3	0.07		A
					mid to EL MIRAGE RD	Stop	1/0/0	250	475	0.5	1	3.24	2010	A
					mid to LOWER BUCK-EYE RD	Stop	1/0/0	57	475	0.1	0.7	0.83		A
SARIVAL AVE / YUMA RD	0.34	0.77	1.52	0	mid to YUMA RD	Stop	1/0/0	181	475	0.4	0.3	0.33		A
					YUMA RD to mid	Stop	1/0/0	202	475	0.4	0.7	1.48	2014	A
					mid to SARIVAL AVE	Stop	1/0/0	102	475	0.2	1.3	2.75	2007	A
MC QUEEN RD / RYAN RD	0.21	1.24	1.7	0	RYAN RD to mid	None	1/0/0	232	1,128	0.2	1.3	1.76	2007	A
					mid to RYAN RD	None	1/0/0	232	1,128	0.2	1.2	1.65	2007	A
103RD AVE / MOUN-TAIN VIEW RD	0.11	0.66	1.3	0	103RD AVE to mid	Stop	1/0/0	6	475	0	1.4	2.76	2007	A
					mid to 103RD AVE	Stop	2/0/0	86	275	0.3	1.1	2.3	2008	A
					mid to MOUNTAIN VIEW RD	None	1/0/0	116	1,338	0.1	0.1	0.11		A
					MOUNTAIN VIEW RD to mid	None	2/0/0	58	1,426	0	0	0.05		A
BALBOA DR / MOUN-TAIN VIEW RD	0.01	0.7	1.39	0	BALBOA DR to mid	Stop	1/0/0	6	475	0	0	0.02		A
					mid to BALBOA DR	Stop	1/0/0	6	475	0	1.4	2.76	2007	A

Year At least One Leg Congested: 2008														
Intersection	**Aver-age V/C**	**Aver-age 2010 V/C**	**Aver-age 2020 V/C**	**Con-gested Legs**	**Leg Name**	**Con-trol**	**Lanes (T/L/R)**	**Peak Lane Vol-ume**	**Peak Lane Ca-pacity**	**V/C**	**2010 V/C**	**2020 V/C**	**Year Con-gested**	**ADT Type (A=Actual, E=Estimate)**
LITCHFIELD RD / NORTHERN AVE	0.56	0.85	1.13	0	LITCHFIELD RD to mid	Signal	1/1/0	328	469	0.7	0.9	1.44	2012	A
					mid to LITCHFIELD RD	Signal	1/1/0	191	435	0.4	1.1	1.1	2008	A
					NORTHERN AVE to mid	Signal	2/0/0	217	410	0.5	0.6	0.85		A
099TH AVE / UNION HILLS DR	0.52	0.61	0.76	0	099TH AVE to mid	Signal	2/0/1	533	664	0.8	0.8	0.86		A
					mid to 099TH AVE	Signal	2/0/0	220	382	0.6	1.1	1.33	2008	A
					mid to UNION HILLS DR	Signal	2/1/1	462	1,040	0.4	0.3	0.45		A
					UNION HILLS DR to mid	Signal	2/1/1	307	1,060	0.3	0.2	0.41		A
CRISMON RD / UNI-VERSITY DR	0.35	0.59	0.71	0	UNIVERSITY DR to mid	Signal	2/1/1	101	534	0.2	0.3	0.39		A
					CRISMON RD to mid	Signal	2/1/0	363	642	0.6	0.9	0.75		A
					mid to CRISMON RD	Signal	2/1/0	287	606	0.5	1.1	1.15	2008	A
					mid to UNIVERSITY DR	Signal	2/1/1	87	524	0.2	0.1	0.54		A
067TH AVE / LOWER BUCKEYE RD	0.15	0.68	1.32	0	mid to LOWER BUCK-EYE RD	Stop	1/1/0	149	1,074	0.1	0.1	0.78		A
					067TH AVE to mid	Stop	1/1/0	149	1,115	0.1	1.2	1.51	2008	A
					mid to 067TH AVE	Stop	1/1/0	199	1,109	0.2	0.8	1.66	2012	A
063RD AVE / LOWER BUCKEYE RD	0.13	1.16	1.51	0	mid to 063RD AVE	None	1/0/0	149	1,115	0.1	1.2	1.51	2008	A

Year At least One Leg Congested: 2009														
Intersection	**Average V/C**	**Average 2010 V/C**	**Average 2020 V/C**	**Congested Legs**	**Leg Name**	**Control**	**Lanes (T/L/R)**	**Peak Lane Volume**	**Peak Lane Capacity**	**V/C**	**2010 V/C**	**2020 V/C**	**Year Congested**	**ADT Type (A=Actual, E=Estimate)**
HORNE RD / MC DOWELL RD	0.4	0.7	1.06	0	HORNE RD to mid	Stop	1/0/0	156	475	0.3	1	1.38	2009	A
					mid to HORNE RD	Stop	1/0/0	226	475	0.5	0.4	0.73		A
MC DOWELL RD / STAPLEY DR	0.33	1.02	1.26	0	mid to STAPLEY DR	Stop	1/0/0	156	475	0.3	1	1.38	2009	A
					STAPLEY DR to mid	Stop	1/0/0	156	475	0.3	1	1.14	2009	A

Year At least One Leg Congested: 2010														
Intersection	**Average V/C**	**Average 2010 V/C**	**Average 2020 V/C**	**Congested Legs**	**Leg Name**	**Control**	**Lanes (T/L/R)**	**Peak Lane Volume**	**Peak Lane Capacity**	**V/C**	**2010 V/C**	**2020 V/C**	**Year Congested**	**ADT Type (A=Actual, E=Estimate)**
LITCHFIELD RD / OLIVE AVE	0.57	0.94	1.5	0	mid to OLIVE AVE	Stop	1/0/0	433	475	0.9	1	1.47	2011	E
					OLIVE AVE to mid	Stop	1/0/0	128	475	0.3	0.9	0.81		A
					mid to LITCHFIELD RD	Stop	1/0/0	169	475	0.4	0.9	1.8	2011	A
					LITCHFIELD RD to mid	Stop	1/0/0	348	475	0.7	1	1.93	2010	A
107TH AVE / MC DOWELL RD	0.44	0.94	2.27	0	mid to MC DOWELL RD	Stop	1/1/0	229	525	0.4	0.9	2.27	2010	A
LITCHFIELD RD / LOWER BUCKEYE RD	0.2	0.45	1.02	0	LITCHFIELD RD to mid	Stop	1/0/0	186	475	0.4	1	2.26	2010	A
					mid to LOWER BUCKEYE RD	None	1/0/0	77	1,259	0.1	0	0		A
					LOWER BUCKEYE RD to mid	None	1/0/1	184	1,331	0.1	0.4	0.81		A

Table 11: Current and Projected Congested Intersections That Are Currently Under Study. Table is sorted by "Year Congested" and "Avg. V/C." Based on the MCDOT HCM.

Intersection	Aver-age V/C	Aver-age 2010 V/C	Aver-age 2020 V/C	Con-gested Legs	Study	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capac-ity	V/C	2010 V/C	2020 V/C	Year Con-gested	ADT Type (A=Actual, E=Estimate)
Year At least One Leg Congested: 2003															
GUADALUPE RD / POWER RD	2.67	2.26	3.45	2	design	mid to GUADALUPE RD	Signal	2/1/0	677	290	2.33	1.7	2.52	2003	A
						GUADALUPE RD to mid	Signal	2/1/0	876	290	3.01	2.82	4.39	2003	A
ELLIOT RD / POWER RD	1.59	1.28	1.82	1	cor	ELLIOT RD to mid	Signal	2/1/0	677	290	2.33	1.7	2.52	2003	A
						mid to ELLIOT RD	Signal	2/1/0	455	528	0.86	0.86	1.12	2015	A
BROWN RD / ELLSWORTH RD	1.28	2.11	2.78	2	DCR	BROWN RD to mid	Stop	1/1/0	580	525	1.1	1.76	1.95	2003	A
						mid to BROWN RD	Stop	1/1/0	761	525	1.45	2.46	3.61	2003	A
GILBERT RD / PE-COS RD	0.89	1.49	3.07	1	DCR	mid to PECOS RD	Stop	1/0/0	304	475	0.64	3.12	6.08	2003	A
						PECOS RD to mid	Stop	1/0/1	885	575	1.54	1.01	1.96	2003	A
						mid to GILBERT RD	Stop	1/0/0	526	1,102	0.48	0.33	1.17	2018	A
083RD AVE / PIN-NACLE PEAK RD	0.86	0.76	1.25	1	DCR	mid to 083RD AVE	Stop	1/0/0	405	475	0.85	0.1	0.35		A
						mid to PINNACLE PEAK RD	Stop	1/0/0	574	475	1.21	2.08	3.06	2003	A
						083RD AVE to mid	Stop	1/1/1	320	625	0.51	0.11	0.34		A
083RD AVE / NORTHERN AVE	0.75	1.38	2.04	1	design	NORTHERN AVE to mid	Signal	1/1/1	554	1,266	0.44	0.82	1.18	2015	E
						083RD AVE to mid	Signal	2/1/0	277	524	0.53	1.14	1.51	2007	E
						mid to 083RD AVE	Signal	1/0/0	565	445	1.27	2.18	3.42	2003	A
BROWN RD / CRISMON RD	0.73	0.67	0.92	1	CAR	mid to CRISMON RD	Stop	1/1/0	536	525	1.02	1.26	1.77	2003	A
						mid to BROWN RD	Stop	1/1/0	243	525	0.46	0.22	0.32		A
						BROWN RD to mid	Stop	1/1/0	250	525	0.48	0.08	0.22		A
						CRISMON RD to mid	Stop	1/1/0	514	525	0.98	1.13	1.36	2003	A
075TH AVE / MC 85	0.69	0.98	1.71	1	DCR	MC 85 to mid	Signal	1/1/0	618	611	1.01	0.97	2.07	2003	A
						mid to 075TH AVE	Signal	2/1/0	237	652	0.36	0.98	1.35	2011	A
BROADWAY RD / CRISMON RD	0.63	0.74	0.79	1	CAR	BROADWAY RD to mid	Signal	2/1/0	87	334	0.26	0.34	0.59		A
						CRISMON RD to mid	Signal	2/1/0	326	822	0.4	0.47	0.44		A
						mid to CRISMON RD	Signal	1/1/0	726	591	1.23	1.4	1.33	2003	A
GERMANN RD / GILBERT RD	0.35	1.42	2.83	0	cor	GERMANN RD to mid	Stop	1/1/0	304	525	0.58	2.82	5.5	2003	A
						GILBERT RD to mid	Stop	1/0/1	255	1,143	0.22	0.32	1.13	2018	A
						mid to GERMANN RD	Stop	1/1/0	273	1,128	0.24	1.13	1.86	2008	A

Intersection	Aver-age V/C	Aver-age 2010 V/C	Aver-age 2020 V/C	Con-gested Legs	Study	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capac-ity	V/C	2010 V/C	2020 V/C	Year Con-gested	ADT Type (A=Actual, E=Estimate)
Year At least One Leg Congested: 2004															
BROWN RD / MERIDIAN RD	0.72	0.63	0.65	0	CAR	BROWN RD to mid	Stop	1/0/0	263	475	0.55	0.42	0.06		A
						mid to BROWN RD	Stop	1/0/0	321	475	0.68	0.27	0.59		A
						mid to MERIDIAN RD	Stop	1/0/0	443	475	0.93	1.19	1.31	2004	A
099TH AVE / INDIAN SCHOOL RD	0.3	1.51	1.91	0	DCR	INDIAN SCHOOL RD to mid	Signal	2/1/0	97	594	0.16	0.77	1.1	2017	A
						mid to 099TH AVE	Signal	2/1/0	103	242	0.43	2.26	2.71	2004	E
COTTON LN / VAN BUREN ST	0.21	0.82	1.52	0	cor	COTTON LN to mid	Stop	2/0/0	45	275	0.16	0.31	0.87		A
						mid to COTTON LN	Stop	2/0/0	10	275	0.04	0.16	0.33		A
						mid to VAN BUREN ST	Stop	2/0/0	72	275	0.26	0.67	1.76	2013	A
						VAN BUREN ST to mid	Stop	2/0/0	106	275	0.39	2.13	3.13	2004	A
099TH AVE / NORTHERN AVE	0.19	1.06	1.27	0	CAR	mid to NORTHERN AVE	Stop	1/0/0	167	475	0.35	2.44	2.84	2004	A
						099TH AVE to mid	None	2/1/0	337	1,942	0.17	0.31	0.5		A
						mid to 099TH AVE	None	2/1/0	109	1,935	0.06	0.43	0.47		A

Intersection	Aver-age V/C	Aver-age 2010 V/C	Aver-age 2020 V/C	Con-gested Legs	Study	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capac-ity	V/C	2010 V/C	2020 V/C	Year Con-gested	ADT Type (A=Actual, E=Estimate)
Year At least One Leg Congested: 2007															
BEARDSLEY RD / EL MIRAGE RD	0.48	0.91	2.17	0	design	mid to EL MIRAGE RD	Stop	1/0/0	257	475	0.54	0.93	1.53	2011	A
						BEARDSLEY RD to mid	Stop	1/0/0	221	475	0.46	0.59	2.71	2012	A
						mid to BEARDSLEY RD	Stop	1/0/0	207	475	0.44	1.22	2.28	2007	E
MERIDIAN RD / SOUTHERN AVE	0.35	0.9	1.03	Intersec-tion	design	mid to MERIDIAN RD	Stop	1/1/0	23	525	0.04	1.3	1.45	2007	A
						mid to SOUTHERN AVE	None	1/0/0	539	1,306	0.41	0.22	0.29		A
						SOUTHERN AVE to mid	Stop	1/0/0	283	475	0.6	1.18	1.36	2007	A
115TH AVE / LOWER BUCKEYE RD	0.26	0.84	2.06	0	Cor	LOWER BUCKEYE RD to mid	Stop	2/0/0	108	275	0.39	0.51	1.02	2020	A
						mid to 115TH AVE	Stop	1/0/0	174	475	0.37	1.22	3.05	2007	A
						mid to LOWER BUCKEYE RD	Stop	2/0/0	62	275	0.22	0.5	1.42	2015	A
						115TH AVE to mid	Stop	1/0/0	29	475	0.06	1.12	2.74	2008	A
COTTON LN / YUMA RD	0.21	0.74	1.91	0	cor	COTTON LN to mid	Stop	1/0/0	102	475	0.22	1.33	2.75	2007	A
						mid to COTTON LN	Stop	1/0/0	71	475	0.15	0.28	1.17	2018	A
						mid to YUMA RD	Stop	1/0/0	85	475	0.18	0.56	1.69	2014	A
						YUMA RD to mid	Stop	1/0/0	143	475	0.3	0.77	2.03	2012	A

Intersection	Aver-age V/C	Aver-age 2010 V/C	Aver-age 2020 V/C	Con-gested Legs	Study	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capac-ity	V/C	2010 V/C	2020 V/C	Year Con-gested	ADT Type (A=Actual, E=Estimate)
Year At least One Leg Congested: 2008															
107TH AVE / LOWER BUCKEYE RD	0.15	0.78	1.62	0	DCR	mid to 107TH AVE	Stop	1/0/0	29	475	0.06	1.12	2.74	2008	A
						mid to LOWER BUCKEYE RD	Stop	1/0/0	111	475	0.23	0.53	0.62		A
						LOWER BUCKEYE RD to mid	Stop	2/0/0	45	275	0.16	0.69	1.5	2014	A

Intersection	Aver-age V/C	Aver-age 2010 V/C	Aver-age 2020 V/C	Con-gested Legs	Study	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capac-ity	V/C	2010 V/C	2020 V/C	Year Con-gested	ADT Type (A=Actual, E=Estimate)
Year At least One Leg Congested: 2009															
BROADWAY RD / MILLER RD	0.31	0.6	1.2	0	CAR	mid to BROADWAY RD	Stop	1/1/0	240	525	0.46	0.52	1.22	2017	A
						mid to MILLER RD	Stop	1/0/0	20	475	0.04	0.72	0.94		A
						MILLER RD to mid	Stop	1/0/0	75	475	0.16	0.16	0.64		A
						BROADWAY RD to mid	Stop	1/1/0	309	525	0.59	1.01	1.99	2009	A
GILBERT RD / QUEEN CREEK RD	0.28	0.61	0.86	0	cor	QUEEN CREEK RD to mid	Stop	1/0/0	273	1,128	0.24	1.04	1.13	2009	A
						GILBERT RD to mid	Stop	1/0/0	318	1,082	0.29	0.35	0.72		A
						mid to GILBERT RD	Stop	1/0/0	354	1,095	0.32	0.7	0.95		A
						mid to QUEEN CREEK RD	Stop	1/0/0	288	1,106	0.26	0.36	0.63		A

Intersection	Aver-age V/C	Aver-age 2010 V/C	Aver-age 2020 V/C	Con-gested Legs	Study	Leg Name	Control	Lanes (T/L/R)	Peak Lane Volume	Peak Lane Capac-ity	V/C	2010 V/C	2020 V/C	Year Con-gested	ADT Type (A=Actual, E=Estimate)
Year At least One Leg Congested: 2010															
099TH AVE / MC DOWELL RD	0.22	0.74	1.42	0	DCR	099TH AVE to mid	Signal	2/2/00	103	370	0.28	0.97	1.87	2010	E
						MC DOWELL RD to mid	Signal	2/1/00	92	588	0.16	0.51	0.97		A

CMS ANALYSIS PROCESS

The annual CMS analysis process requires several steps to identify congested County roads (Figure 4). The first step involves collecting traffic counts, converting them to Average Daily Traffic (ADT) and projecting future ADT values for the road network. The MCDOT Traffic Engineering Section collects traffic counts for only a portion of the County system each year. Current year congestion totals were derived from two sources; previous year counts and the MCDOT Roadway Management System (RMS) estimates where previous year counts are unavailable. However, not all County roadways have traffic counts or RMS estimates available.

Secondly, v/c indices were calculated for each road segment based on the MCDOT Roadway Design Manual criteria, Highway Capacity Manual criteria and absolute roadway capacities. The segments are ranked according to their V/C indices and V/C ratios and those that score less than 1.00 are not considered for further analysis.

In the third step, the highest-ranking projects were considered for Candidate Assessment Report (CAR) development based on their potential for improvement. Those projects considered for CAR development were evaluated based on several additional factors including safety, pavement condition, and environmental considerations.

MCDOT tracks all potential projects. A list of those projects is compiled that designates their status i.e., constructed, designed, those that have Design Concept Reports, and those with Candidate Assessment Reports (CAR), see Table 12. Eighteen CMS projects have been placed into or advanced to the project pool since fiscal year 2000. In addition, a system wide congestion measure was developed and used to assess congestion on the network. The formula is as follows:

$$\text{System Wide Congestion Measure} = \frac{?(V/C * VMT)}{?(\text{VMT of all segments})}$$

The system wide congestion measure equals the sum of the volume to capacity ratio multiplied by the vehicle miles traveled for each road segment, divided by the sum of the vehicle miles traveled for all road segments for all roads in the RMS database. Higher values equate to more congested conditions. The measure yielded a value of 0.62 for FY 2000, 0.79 for FY 2001, 0.88 for FY 2002 and 0.84 for FY 2003 for all segments where ADT values or interpolated ADT values exist (approximately 5,900 out of 9,200 segments). Since most of the traffic counts were taken within or adjacent to urbanized areas and all of the ADT's were collected on paved roads, these system wide values may be higher than actually exists for the entire network.

Figure 4: CMS Analysis Process

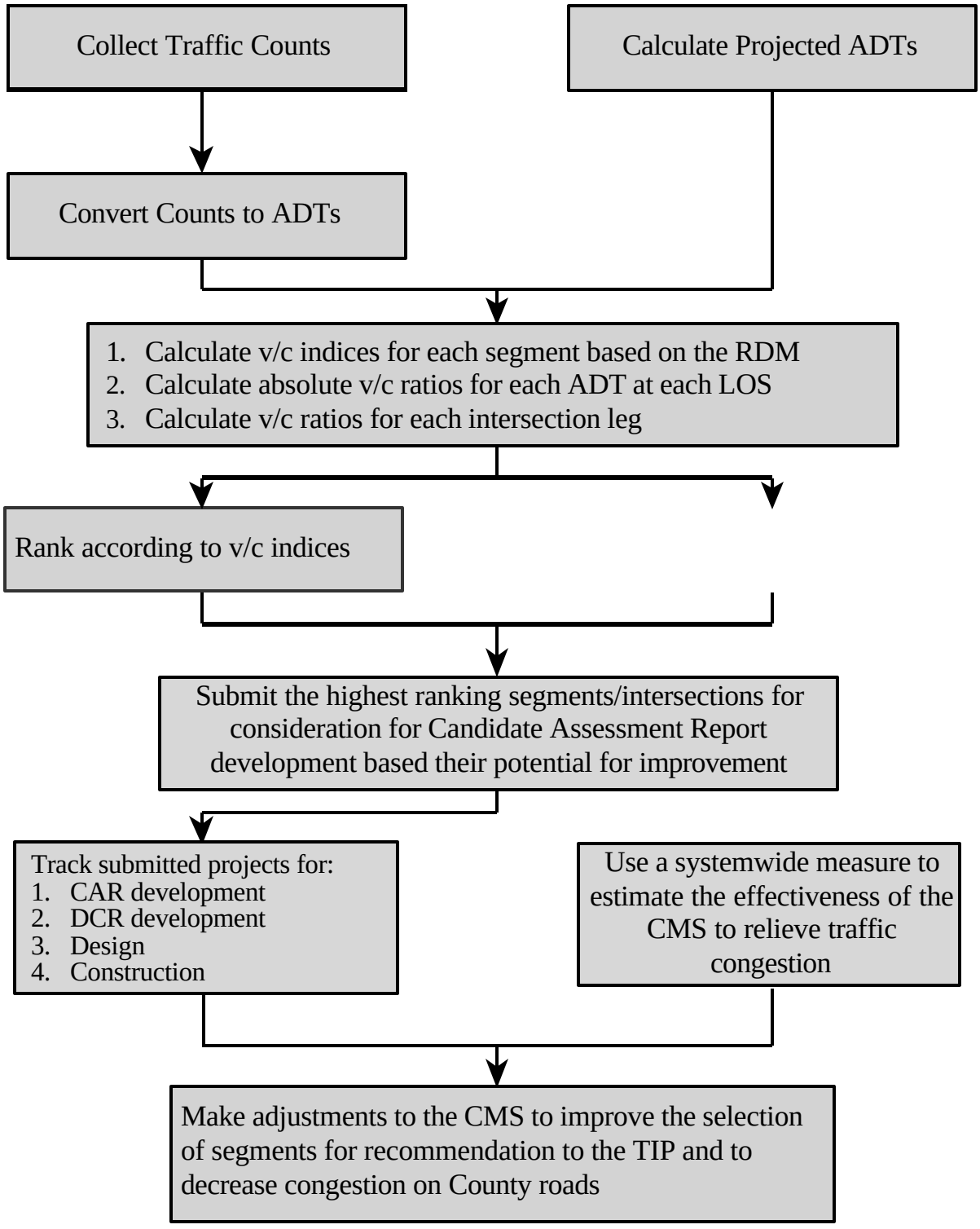


Table 12: Road Segments in the 2000 to 2003 CMS that were Advanced for Further Study or Construction

Road Name	Beginning Point	Ending Point	FY 2000 Status	FY 2001 Status	FY 2002 Status	FY 2003 Status
51st Ave	Baseline Rd	Phoenix C/L	DCR	Design	Design	Construction
51st Ave	Dobbins Rd	Baseline Rd	DCR	Design	Design	Construction
51st Ave	Elliot Rd	Dobbins Rd	DCR	Design	Design	Construction
51st Ave	GRIR Boundary	Estrella Dr	DCR	Design	Design	Construction
75th Ave	MC 85	Van Buren St	DCR	DCR	DCR	Design
Brown Rd	Crismon Rd	Signal Butte Rd	CMS	CAR	CAR	CAR
Brown Rd	Ellsworth Rd	Crismon Rd	CMS	CAR	CAR	DCR
Deer Valley Rd	83rd Ave	Glendale C/L	CMS	DCR	Construction	Construction
Elliot Rd	Hawes Rd	Ellsworth Rd	CMS	CAR	CAR	CAR
Elliot Rd	Sossaman Rd	Hawes Rd	CMS	CAR	CAR	CAR
Gilbert Rd	McDowell Rd	SR 87	Design	Construction	Construction	Construction
Higley Rd	Ray Rd	Warner Rd	CMS	CAR	CAR	CAR
Indian School Rd	Indian School Ln	Dysart Rd			CMS	CAR
Lake Pleasant Rd	Deer Valley Dr	Pinnacle Peak Rd	CMS	DCR	DCR	Annexed
Loop 303	Indian School Rd	Clearview Ave	CMS	Alignment Study	DCR	DCR
Pinnacle Peak Rd	91st Ave	83rd Ave	CMS	CAR	CAR	DCR
Power Rd	Ray Rd	Warner Rd	CMS	CMS	Corridor Study	Corridor Study
Williams Field Rd	Gilbert C/L	Lindsay Rd	DCR	Design	Design	Design

Additional Findings

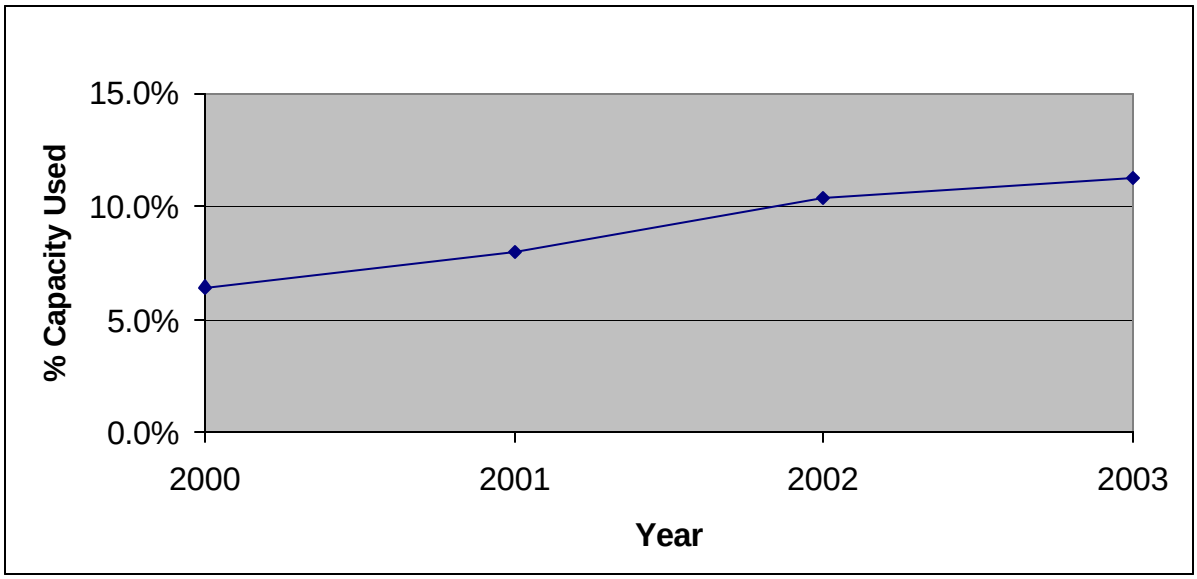
Further analysis shows the MCDOT roadway system has experienced a decline in capacity and an increase in ADT values causing the increased system wide congestion measure value (Figure 5). The capacity of County roads (weighted by their segment length) was 9,575 in FY 2000, 9,261 in FY 2002 and 9,459 in FY 2003. Their average traffic volumes (weighted by segment length) were 615 vehicles per lane-mile in FY 2000, 956 vehicles per lane-mile in FY 2002 and 1,063 vehicles per lane-mile in FY 2003. The volume/capacity ratio has also increased significantly since FY 2000.

The trend in decreasing capacity from FY 2000 to FY 2002 is likely due to the annexations of urban county roads by the cities that reduced the number of higher capacity County roadways, while the increase from FY 2002 to FY 2003 was likely caused by MCDOT dropping several local 2-lane roads from the system. The increasing average traffic volumes are likely caused by rapid population growth in the adjacent urban areas. During the last four years, 142 miles of County roads have been annexed into adjacent cities and towns or removed from the system. In FY 1999, Maricopa County had 2,822 miles of roadway in its system compared to 2,680

miles in FY 2003.

Most of the congestion on County roads occurs adjacent to fully developed or developing areas (Figures 7 - 9). The majority of these segments are in county islands or immediately adjacent to incorporated areas. Their locations make them likely candidates for cost sharing improvements and subsequent annexation by adjacent cities and towns. This situation is positive for the County, but creates a negative appearance on congestion management. Once annexation occurs, these segments are no longer in the County network and therefore their improvements, or reduced v/c values, are no longer reflected in traffic congestion analyses. Actual improvements to the network will have occurred, but will not be realized when assessing the condition of the system.

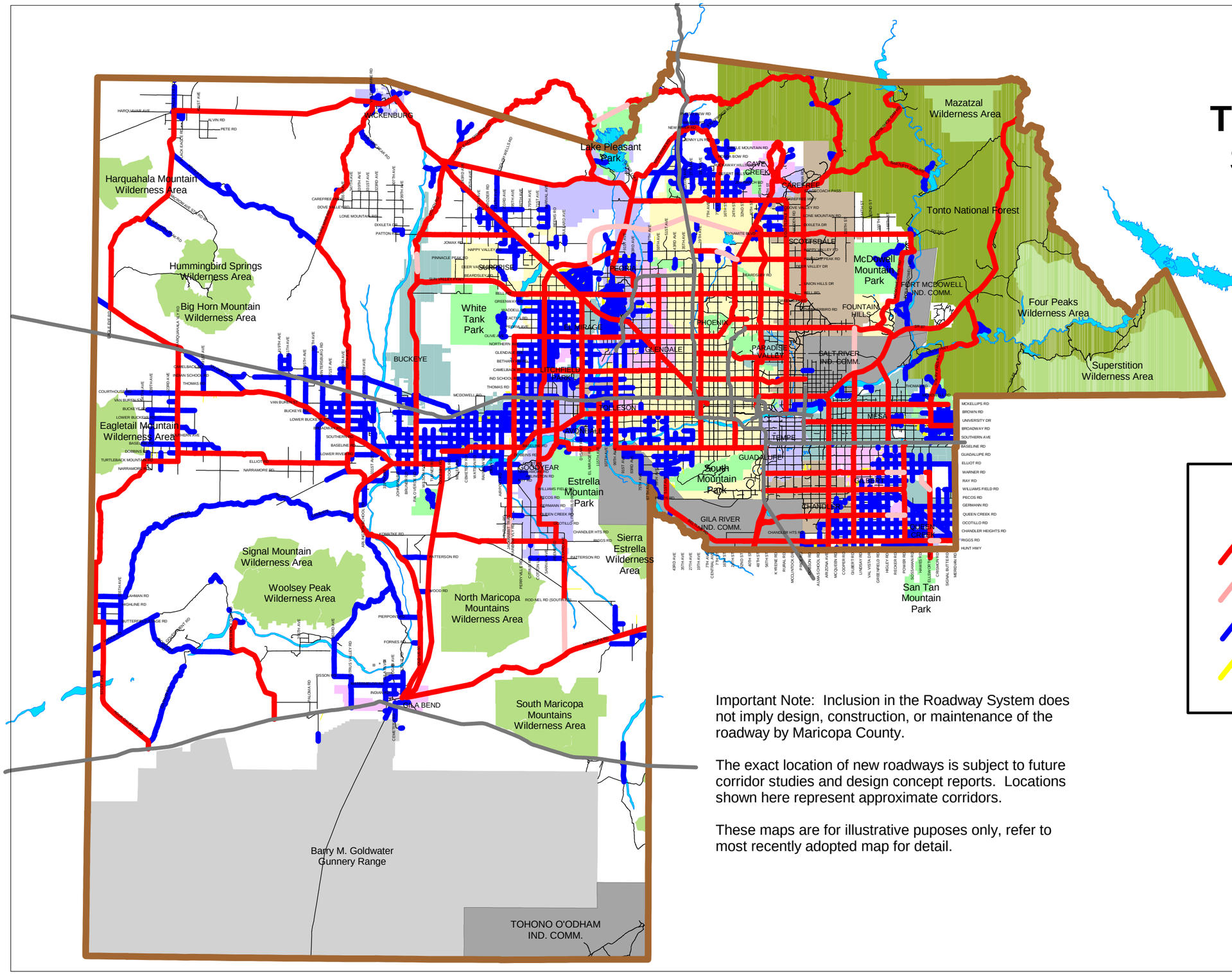
Figure 5: Trend in Capacity Used on County Roads



Future congestion appears to occur for much the same reasons as current congestion, with most taking place on county islands and adjacent to incorporated areas (Figures 10 - 12). The projections suggest areas on the southeast and southwest fringes of the Phoenix urban area will experience a more immediate need for congestion reduction measures than will their northern counterparts.

Based on absolute capacities (capacities at Level of Service F), most of the congested roads will be in the west and southeast areas of the urbanized area (Figures 13 - 15). In addition, most of the identified segments occur in the years 2010 and 2020 periods, notably later than when based on Roadway Design Manual criteria. MCDOT will make adjustments to the CMS annually to improve the selection of segments for recommendation to the TIP and decrease congestion on the County network.

Transportation System Plan



LEGEND

- Primary Road (existing)
- Primary Road (future)
- Secondary Road
- Local Road

Important Note: Inclusion in the Roadway System does not imply design, construction, or maintenance of the roadway by Maricopa County.

The exact location of new roadways is subject to future corridor studies and design concept reports. Locations shown here represent approximate corridors.

These maps are for illustrative puposes only, refer to most recently adopted map for detail.

N

0 2 4 6 Miles

Currently Congested County Roads

Based on MCDOT Roadway Design Manual Criteria

MCDOT

LEGEND

- Congested Road
- Currently Under Study
- County Line
- PM-10 Boundary
- CO/Ozone Boundary

INSET MAP

Maricopa County

Vulture Mine Rd

60

Lone Mountain Rd
Dixileta Dr
Patton Rd
Jomax Rd
Happy Valley Rd
Pinnacle Peak Rd
Deer Valley Rd
Beardsley Rd
Union Hills Dr
Bell Rd
Greenway Rd
Waddell Rd
Cactus Rd
Peoria Ave
Olive Ave
Northern Ave
Glendale Ave
Bethany Home Rd
Camelback Rd

Citrus Rd
Cotton Ln
Sarival Ave
Reems Rd
Bullard Ave
Litchfield Rd
Dysart Rd
El Mirage Rd
115th Ave
107th Ave
99th Ave
91st Ave
83rd Ave
75th Ave
67th Ave
59th Ave
51st Ave
43rd Ave
35th Ave
27th Ave
19th Ave
7th Ave
7th St
16th St
24th St
32nd St
40th St
48th St
56th St

Desert Hills Dr
Joy Ranch Rd
Cloud Rd
Carefree Hwy

CAVE CREEK
PEORIA
SURPRISE
EL MIRAGE
BUCKEYE
GLENDALE
PHOENIX

101
51

N

Currently Congested County Roads

Based on MCDOT Roadway Design Manual Criteria

MCDOT

LEGEND

- Congested Road
- Currently Under Study
- County Line
- PM-10 Boundary
- CO/Ozone Boundary

INSET MAP

Maricopa County

Northern Ave
Glendale Ave
Bethany Home Rd
Camelback Rd
Indian School Rd
Thomas Rd
McDowell Rd
Van Buren St
Yuma Rd
Lower Buckeye Rd
Broadway Rd
Southern Ave
Baseline Rd
Beloat Rd
Old US 80
Narramore Rd
Ray Rd

Queen Creek Rd
Ocotillo Rd
Chandler Heights Rd
Riggs Rd
Patterson Rd

Miller Rd
Apache Rd
Watson Rd
Rainbow Rd
Dean Rd
Airport Rd
Tuthill Rd
Perryville Rd
Citrus Rd
Cotton Ln
Sarival Ave
Reems Rd
Bullard Ave
Litchfield Rd
Dysart Rd
El Mirage Rd
115th Ave
107th Ave
99th Ave
91st Ave
83rd Ave
75th Ave
67th Ave
59th Ave
51st Ave
43rd Ave
35th Ave
27th Ave

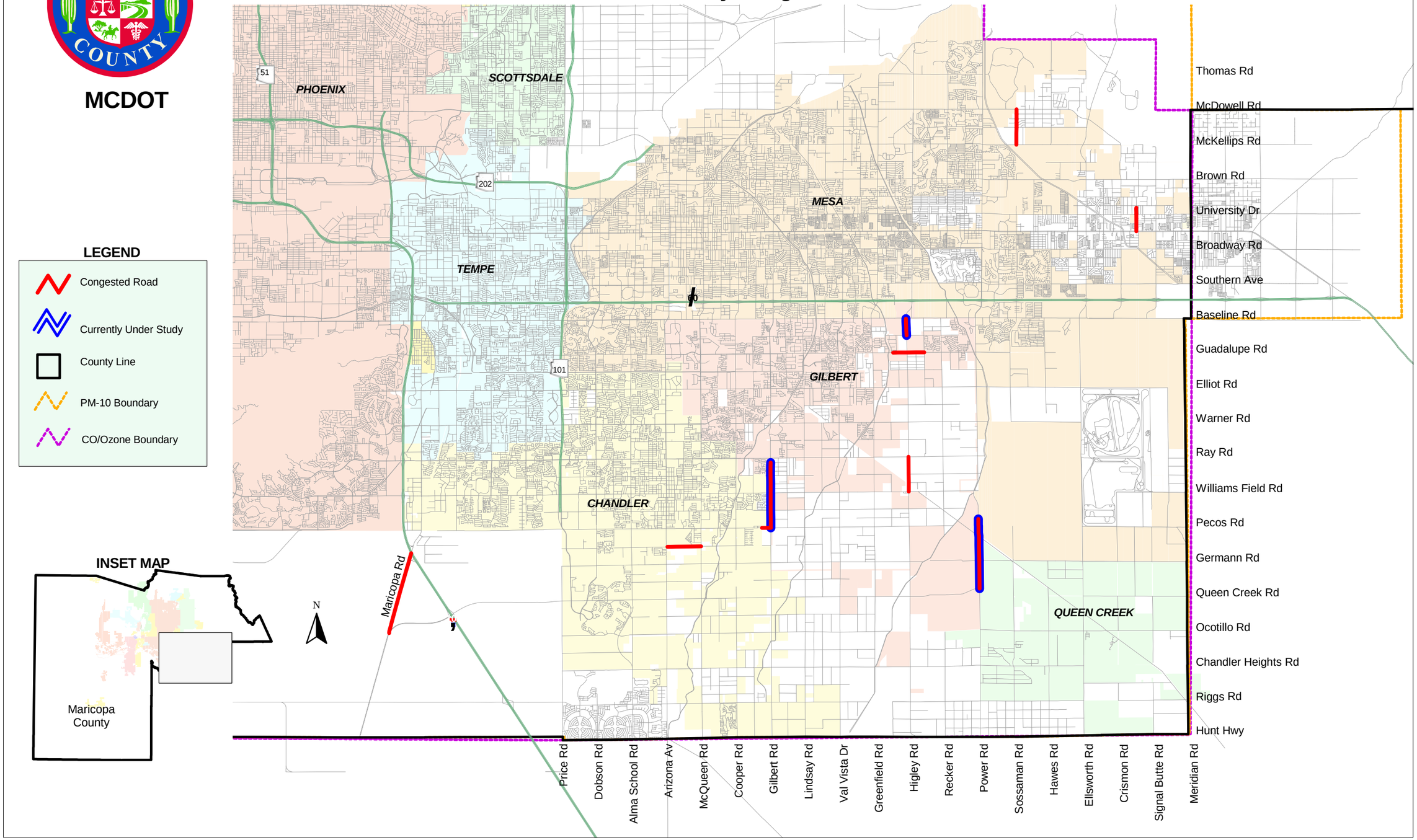
PEORIA
GLENDALE
PHOENIX
AVONDALE
TOLLESON
BUCKEYE
GOODYEAR
MC 85

N

MCDOT

Currently Congested County Roads

Based on MCDOT Roadway Design Manual Criteria



Projection of Congested County Roads

Based on MCDOT Roadway Design Manual Criteria

MCDOT

LEGEND

- Year 2010
- Year 2020
- Currently Under Study
- County Line
- PM-10 Boundary
- CO/Ozone Boundary

INSET MAP

Maricopa County

Note: Only primary and secondary system routes are shown.

Patton Rd
Jomax Rd
Happy Valley Rd
Pinnacle Peak Rd
Deer Valley Rd
Beardsley Rd
Union Hills Dr
Bell Rd
Greenway Rd
Waddell Rd
Cactus Rd
Peoria Ave
Olive Ave
Northern Ave
Glendale Ave
Bethany Home Rd
Camelback Rd

Citrus Rd
Cotton Ln
Sarival Ave
Reems Rd
Bullard Ave
Litchfield Rd
Dysart Rd
El Mirage Rd
115th Ave
107th Ave
99th Ave
91st Ave
83rd Ave
75th Ave
67th Ave
59th Ave
51st Ave
43rd Ave
35th Ave
27th Ave
19th Ave
7th Ave
7th St
16th St
24th St

48th St
56th St

60
101
51

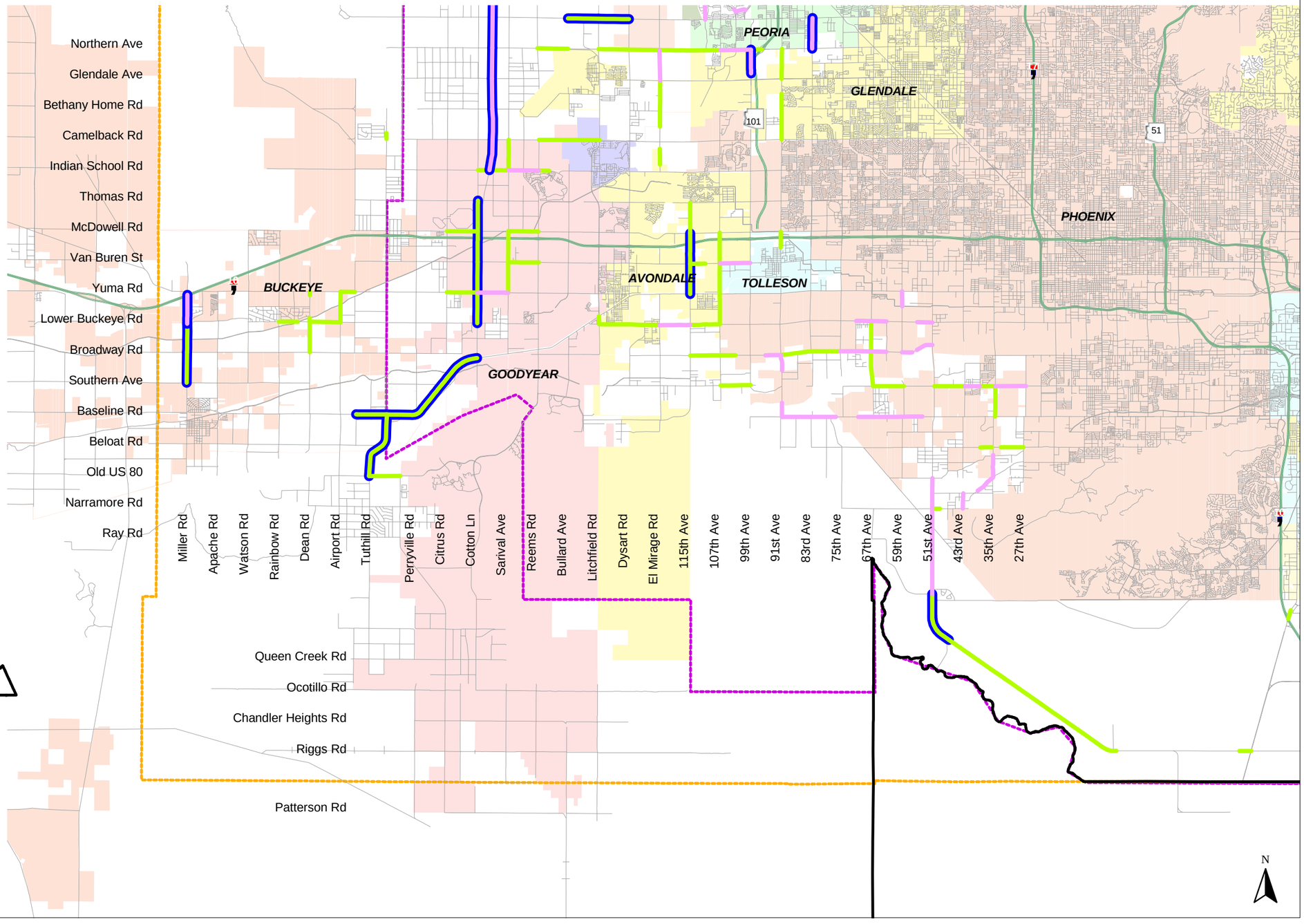
CAVE CREEK
PEORIA
SURPRISE
EL MIRAGE
PHOENIX
GLENDALE
BUCKEYE

N

Projection of Congested County Roads

Based on MCDOT Roadway Design Manual Criteria

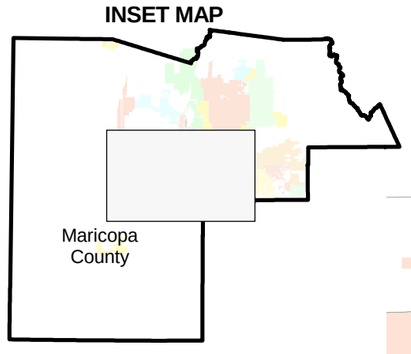
MCDOT



LEGEND

- Year 2010
- Year 2020
- Currently Under Study
- County Line
- PM-10 Boundary
- CO/Ozone Boundary

INSET MAP

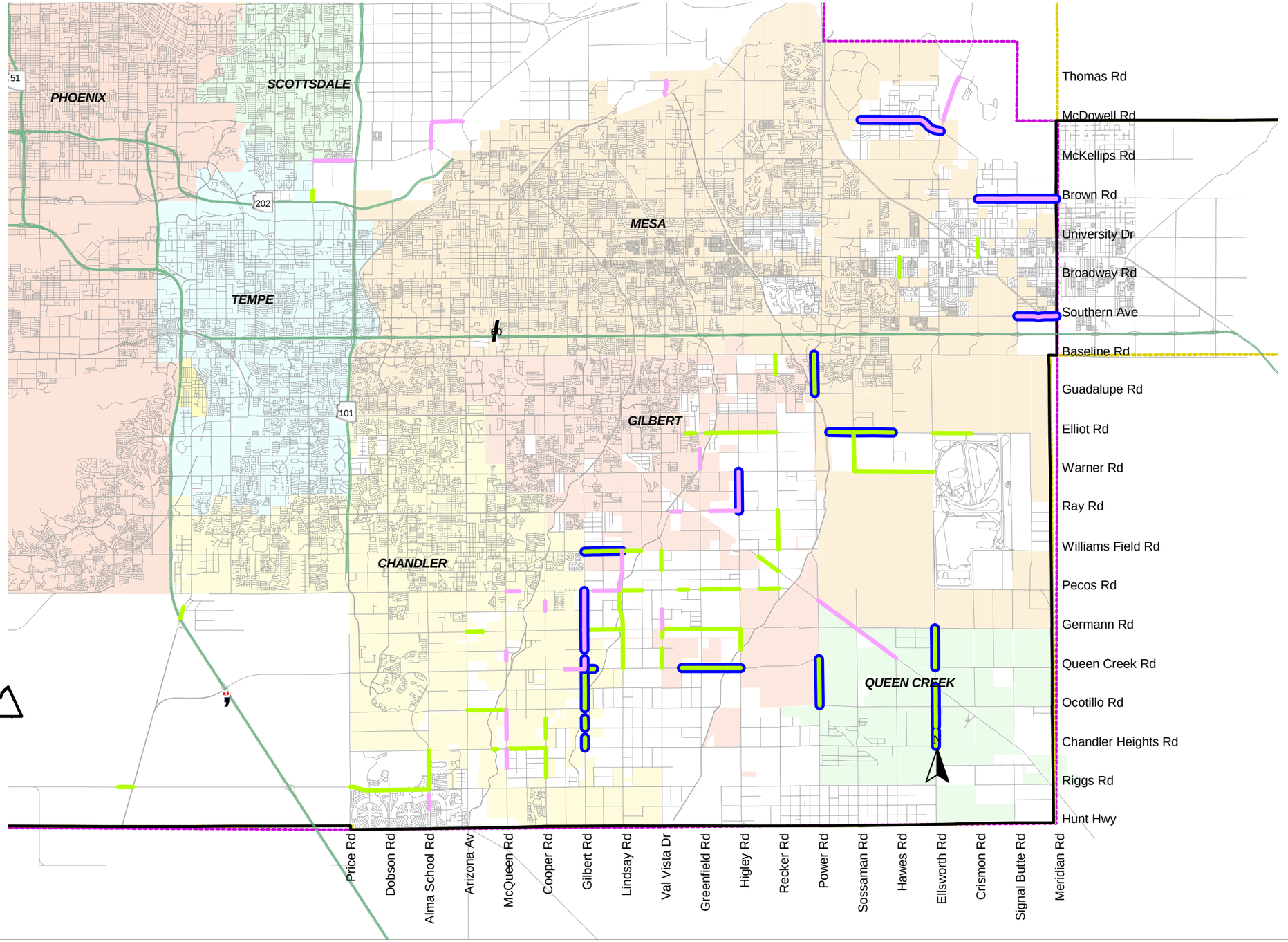


Note: Only primary and secondary system routes are shown.

Projection of Congested County Roads

Based on MCDOT Roadway Design Manual Criteria

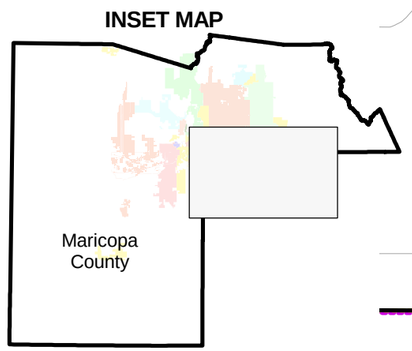
MCDOT



LEGEND

- Year 2010
- Year 2020
- Currently Under Study
- County Line
- PM-10 Boundary
- CO/Ozone Boundary

INSET MAP



Note: Only primary and secondary system routes are shown.

Congested County Roads

Current and Projected Based on Absolute Capacities (LOS F)

MCDOT

LEGEND

- Congested 2003
- Congested 2010
- Congested 2020
- Currently Under Study
- County Line
- PM-10 Boundary
- CO/Ozone Boundary

INSET MAP

Maricopa County

Vulture Mine Rd

Lone Mountain Rd
Dixileta Dr
Patton Rd
Jomax Rd
Happy Valley Rd
Pinnacle Peak Rd
Deer Valley Rd
Beardsley Rd
Union Hills Dr
Bell Rd
Greenway Rd
Waddell Rd
Cactus Rd
Peoria Ave
Olive Ave
Northern Ave
Glendale Ave
Bethany Home Rd
Camelback Rd

Citrus Rd
Cotton Ln
Sarival Ave
Reems Rd
Bullard Ave
Litchfield Rd
Dysart Rd
El Mirage Rd
115th Ave
107th Ave
99th Ave
91st Ave
83rd Ave
75th Ave
67th Ave
59h Ave
51st Ave
43rd Ave
35th Ave
27th Ave
19th Ave
7th Ave
7th St
16th St
24th St
32nd St
40th St
48th St
56th St

Desert Hills Dr
Joy Ranch Rd
Cloud Rd
Carefree Hwy

CAVE CREEK
PEORIA
SURPRISE
EL MIRAGE
GLENDALE
PHOENIX
BUCKEYE

101
51

Congested County Roads

Current and Projected Based on Absolute Capacities (LOS F)

MCDOT

LEGEND

- Congested 2003
- Congested 2010
- Congested 2020
- Currently Under Study
- County Line
- PM-10 Boundary
- CO/Ozone Boundary

INSET MAP

Maricopa County

PEORIA
GLENDALE
PHOENIX
BUCKEYE
AVONDALE
TOLLESON
GOODYEAR
MC 85

Northern Ave
Glendale Ave
Bethany Home Rd
Camelback Rd
Indian School Rd
Thomas Rd
McDowell Rd
Van Buren St
Yuma Rd
Lower Buckeye Rd
Broadway Rd
Southern Ave
Baseline Rd
Beloat Rd
Old US 80
Narramore Rd
Ray Rd

Miller Rd
Apache Rd
Watson Rd
Rainbow Rd
Dean Rd
Airport Rd
Tuthill Rd
Perryville Rd
Citrus Rd
Cotton Ln
Sarival Ave
Reems Rd
Bullard Ave
Litchfield Rd
Dysart Rd
El Mirage Rd
115th Ave
107th Ave
99th Ave
91st Ave
83rd Ave
75th Ave
67th Ave
59th Ave
51st Ave
43rd Ave
35th Ave
27th Ave

Queen Creek Rd
Ocotillo Rd
Chandler Heights Rd
Riggs Rd
Patterson Rd

N

Congested County Roads

Current and Projected Based on Absolute Capacities (LOS F)

MCDOT

LEGEND

- Congested 2003
- Congested 2010
- Congested 2020
- Currently Under Study
- County Line
- PM-10 Boundary
- CO/Ozone Boundary

INSET MAP

Maricopa County

PHOENIX
SCOTTSDALE
TEMPE
MESA
GILBERT
CHANDLER
QUEEN CREEK
51
202
101
10
Maricopa Rd

Thomas Rd
McDowell Rd
McKellips Rd
Brown Rd
University Dr
Broadway Rd
Southern Ave
Baseline Rd
Guadalupe Rd
Elliot Rd
Warner Rd
Ray Rd
Williams Field Rd
Pecos Rd
Germann Rd
Queen Creek Rd
Ocotillo Rd
Chandler Heights Rd
Riggs Rd
Hunt Hwy

Price Rd
Dobson Rd
Alma School Rd
Arizona Av
McQueen Rd
Cooper Rd
Gilbert Rd
Lindsay Rd
Val Vista Dr
Greenfield Rd
Higley Rd
Recker Rd
Power Rd
Sossaman Rd
Hawes Rd
Ellsworth Rd
Crismon Rd
Signal Butte Rd
Meridian Rd

N